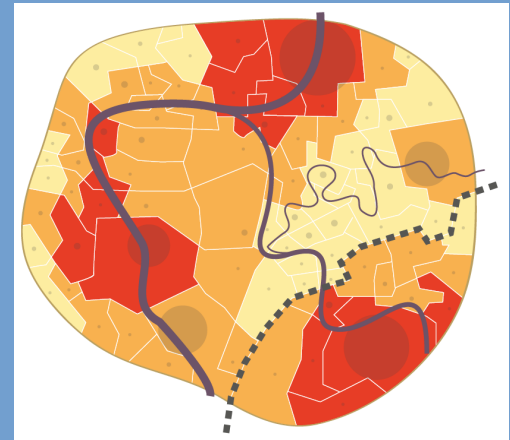
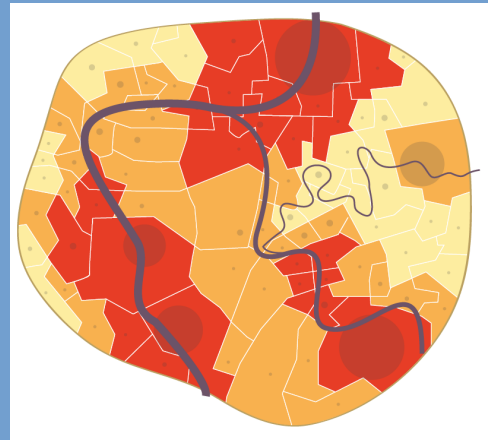
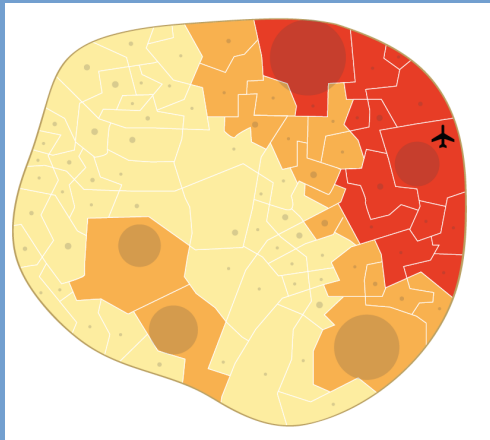
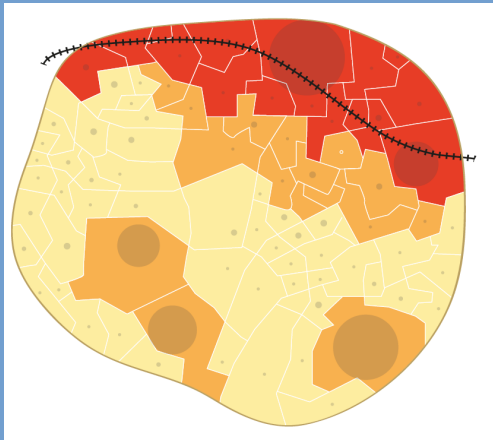


# Enhancing Spatial Patterns Representations by Functional Semantic Simplification

An Interactive Tool for European Stakeholders



**Timothée Giraud**  
**Nicolas Lambert**  
**Hadrien Commenges**



1

## **MAUP** (Modifiable Area Unit Problem)

*What is it?*

*Issues*

*How to solve it ?*

2

## **Functional Indicators**

*Spatial interaction modeling*

*Enhancing spatial patterns*

*Automatic computation*

3

## **A European tool (FIT)**

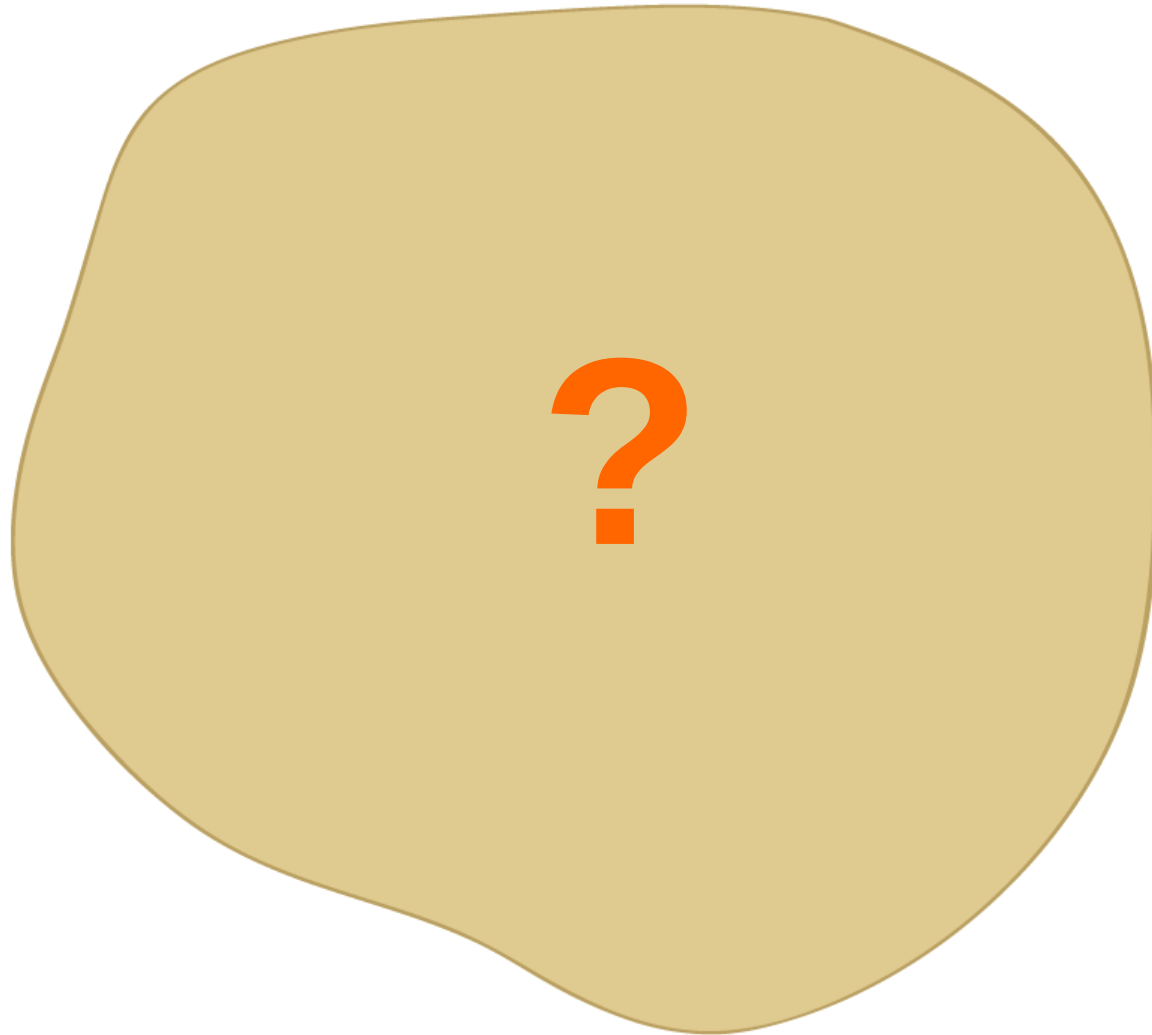
*Features*

*Interest*

*Reproducibility*

# **MILESTONES**

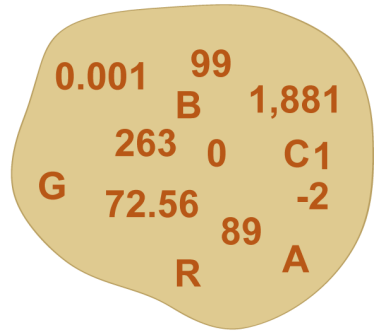
# MAUP (Modifiable Area Unit Problem)



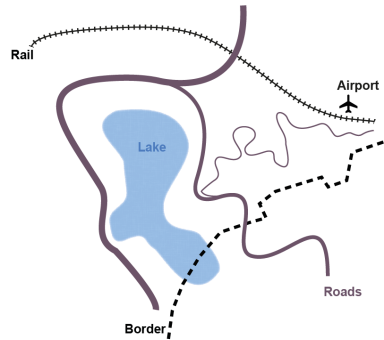
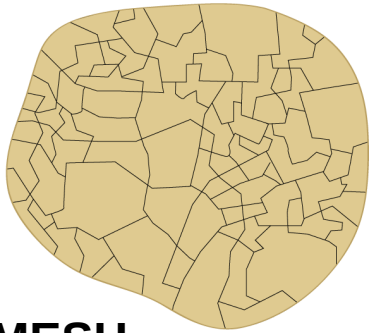
**The reality  
is complex.**

**A map has to  
be simple.**

# MAUP (Modifiable Area Unit Problem)

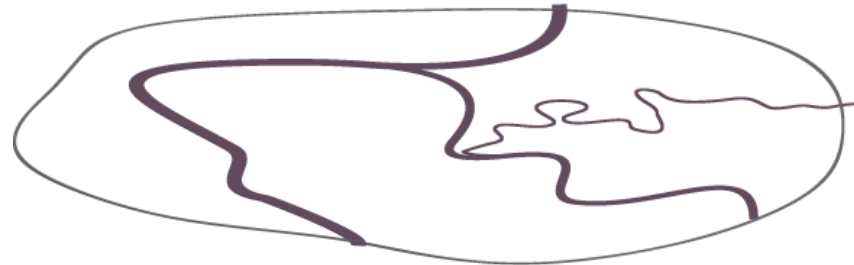
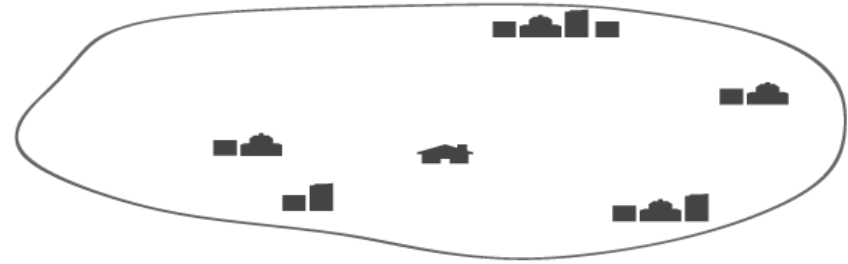
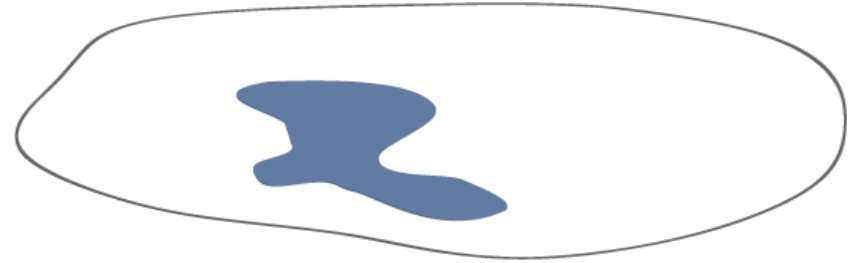


DATA

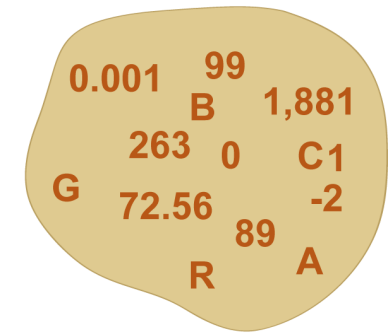


NATURAL AND  
ANTHROPIC FEATURES

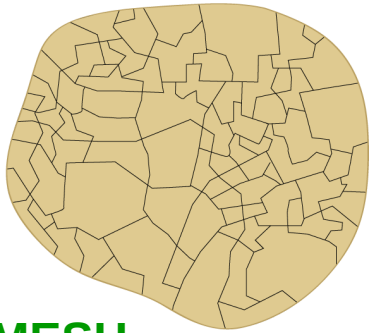
MODELING REALITY



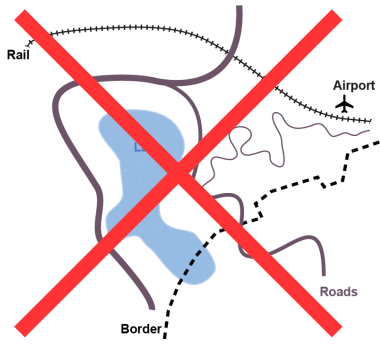
# MAUP (Modifiable Area Unit Problem)



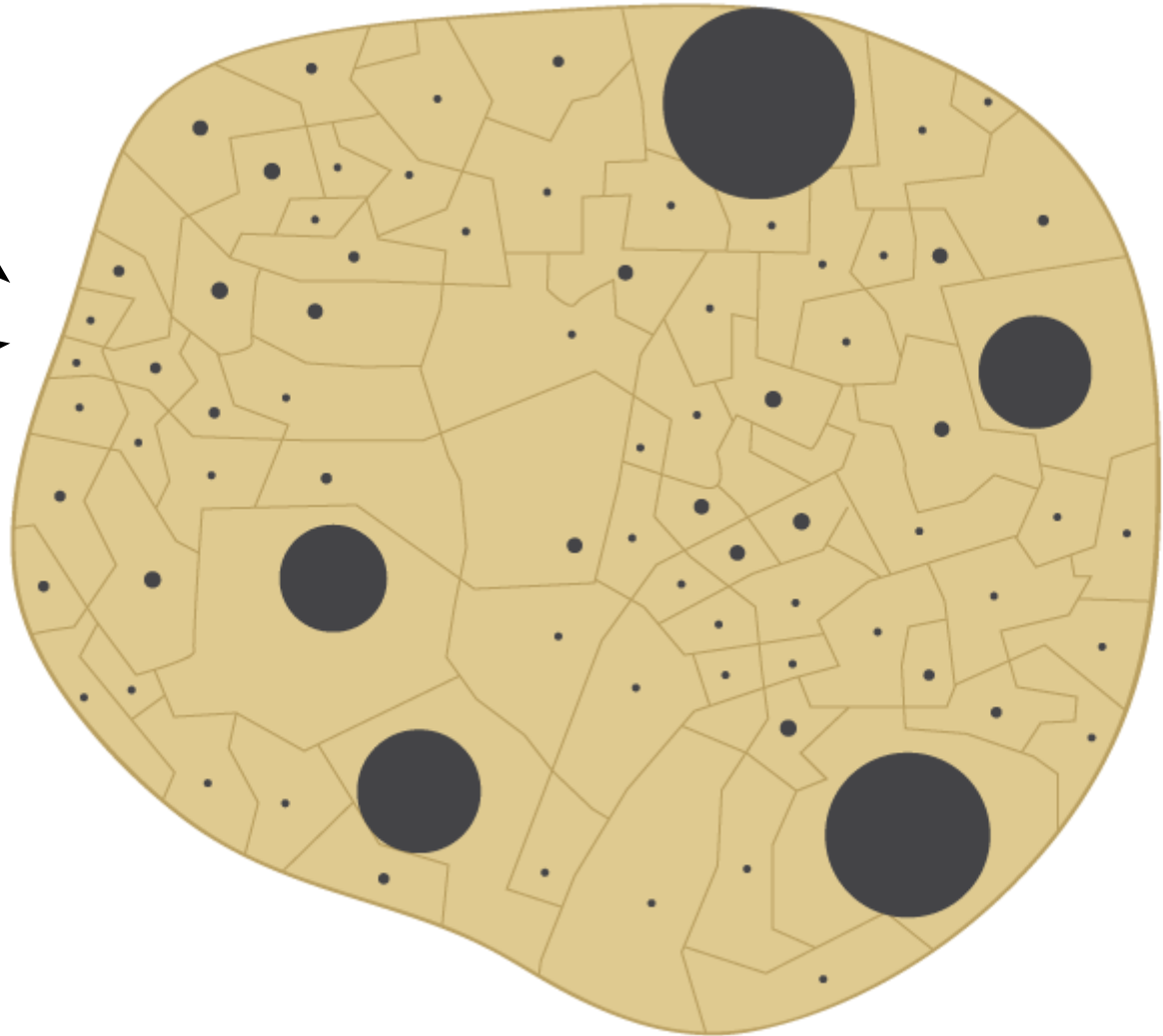
DATA



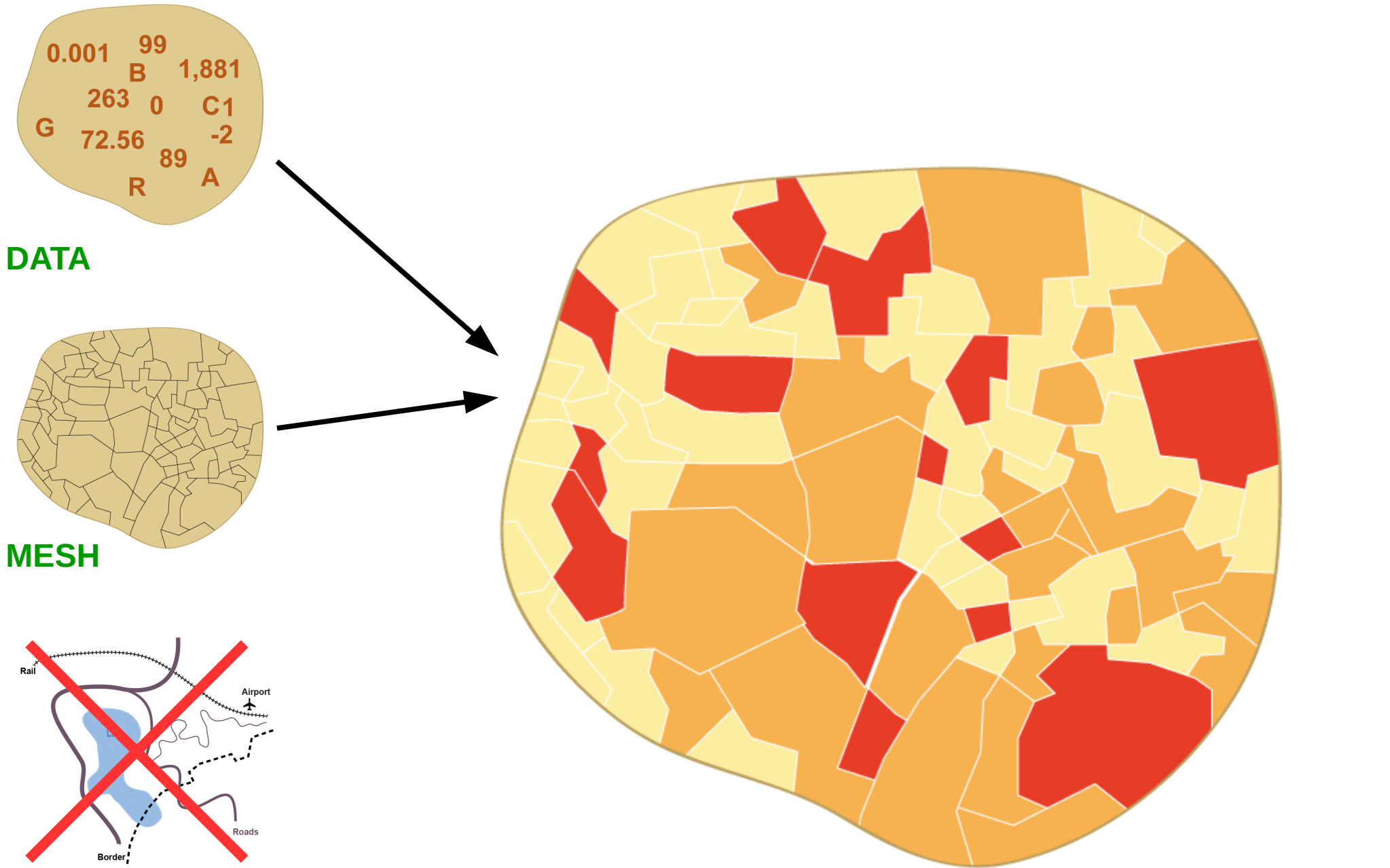
MESH



NATURAL AND  
ANTHROPIC FEATURES



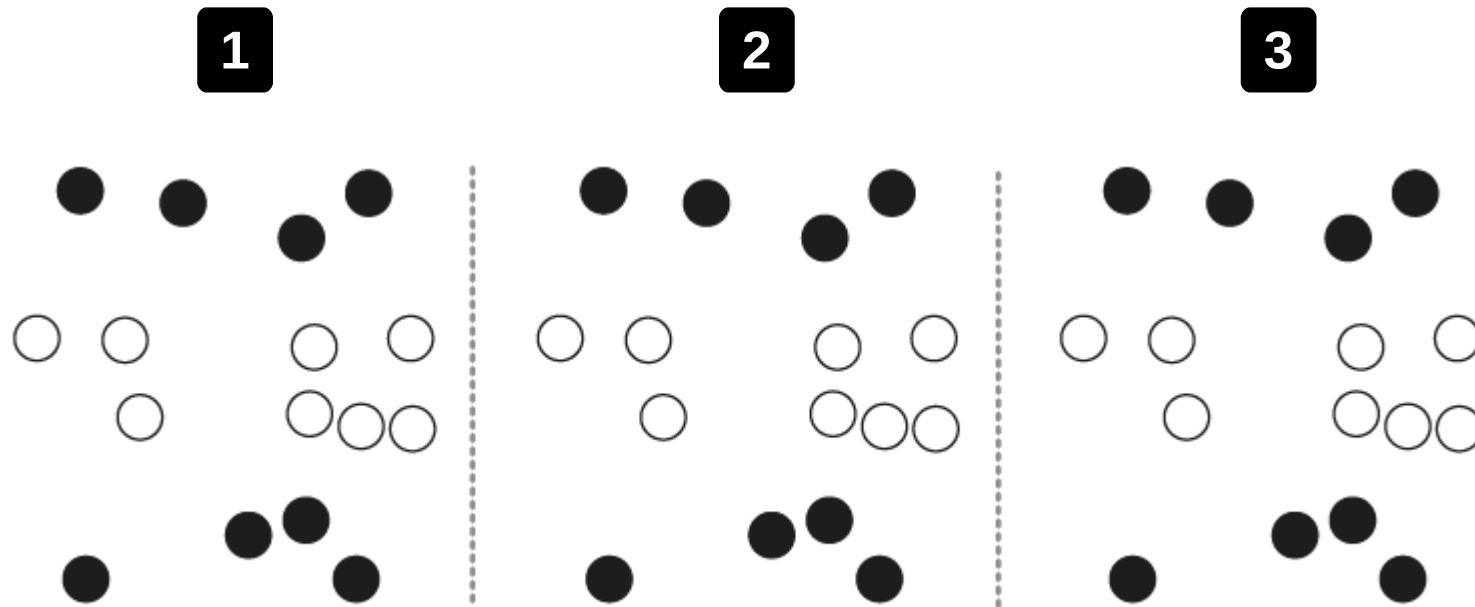
# MAUP (Modifiable Area Unit Problem)



**NATURAL AND  
ANTHROPIC FEATURES**

Choropleth Maps

# MAUP (Modifiable Area Unit Problem)

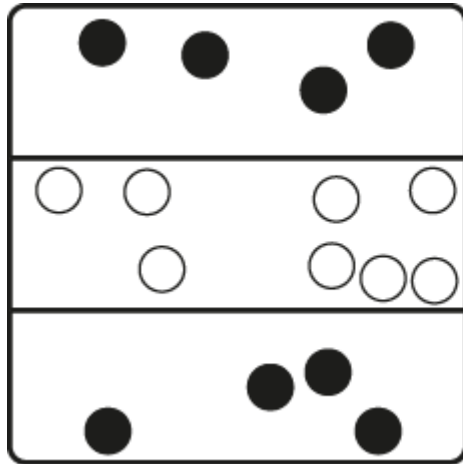


Same reality

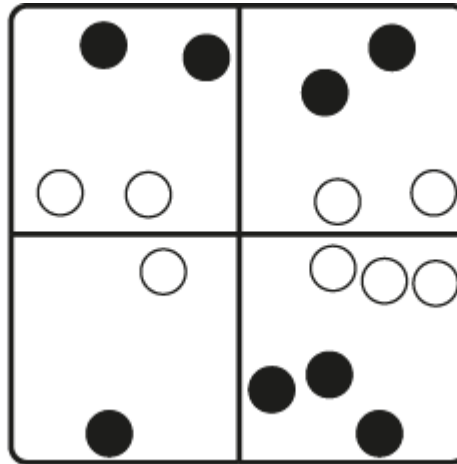


# MAUP (Modifiable Area Unit Problem)

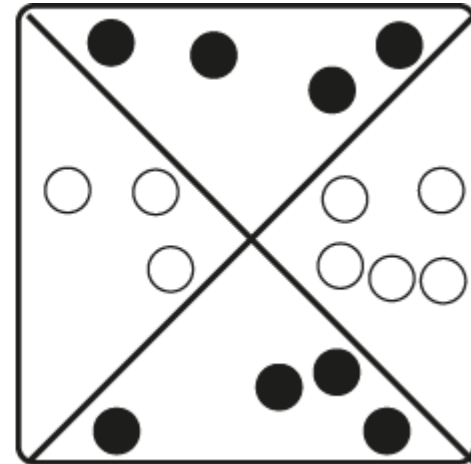
1



2



3



Several grids

People

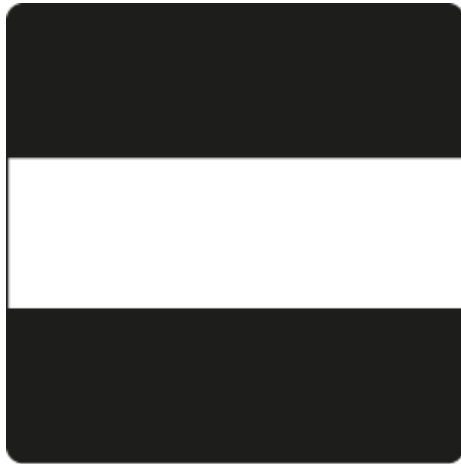
○ Poor

● Rich

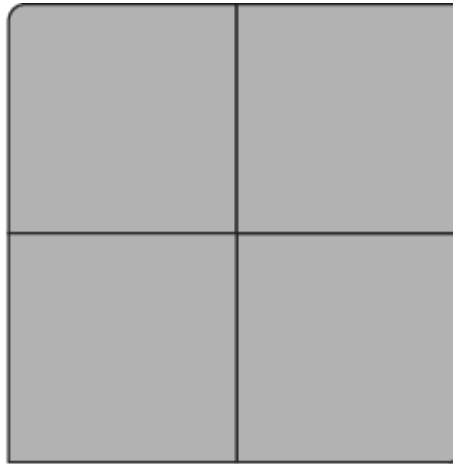


# MAUP (Modifiable Area Unit Problem)

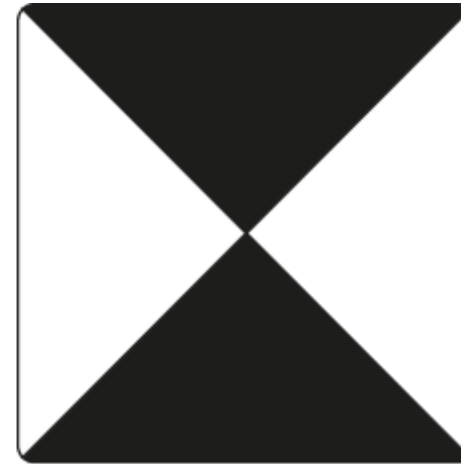
1



2

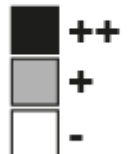


3



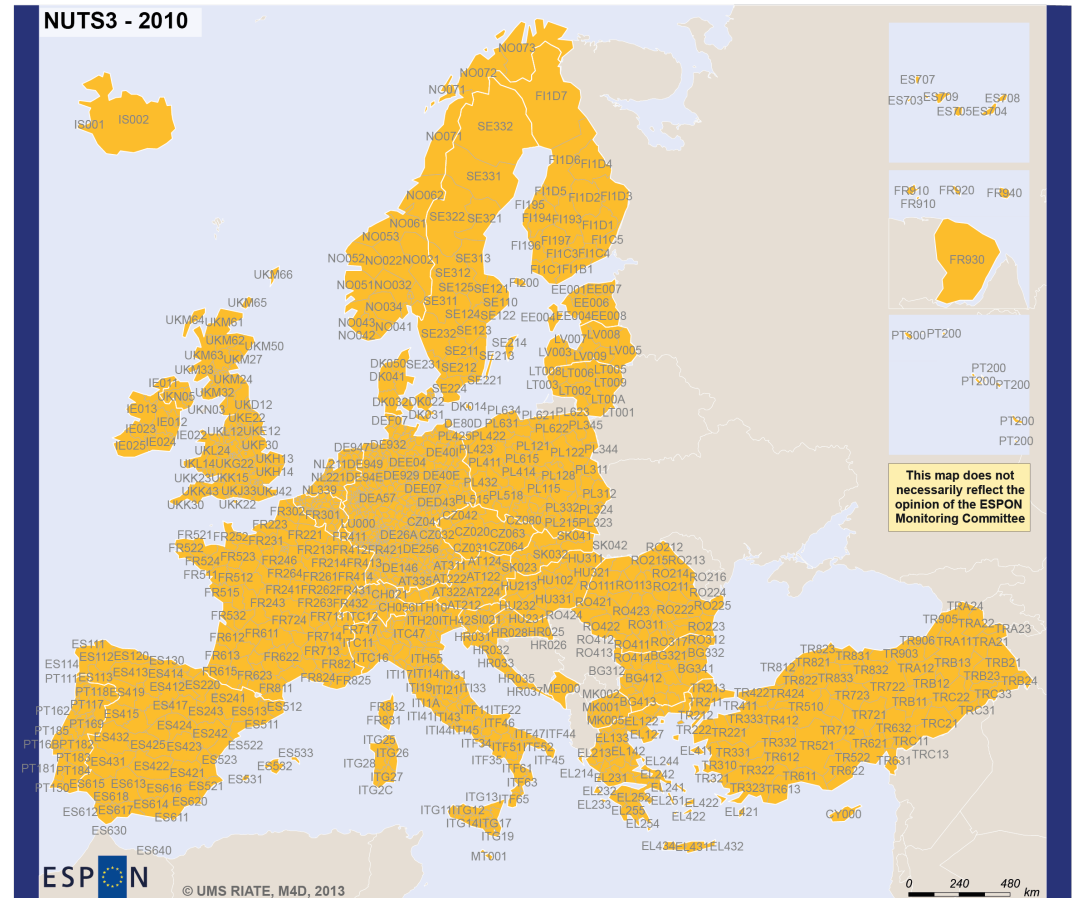
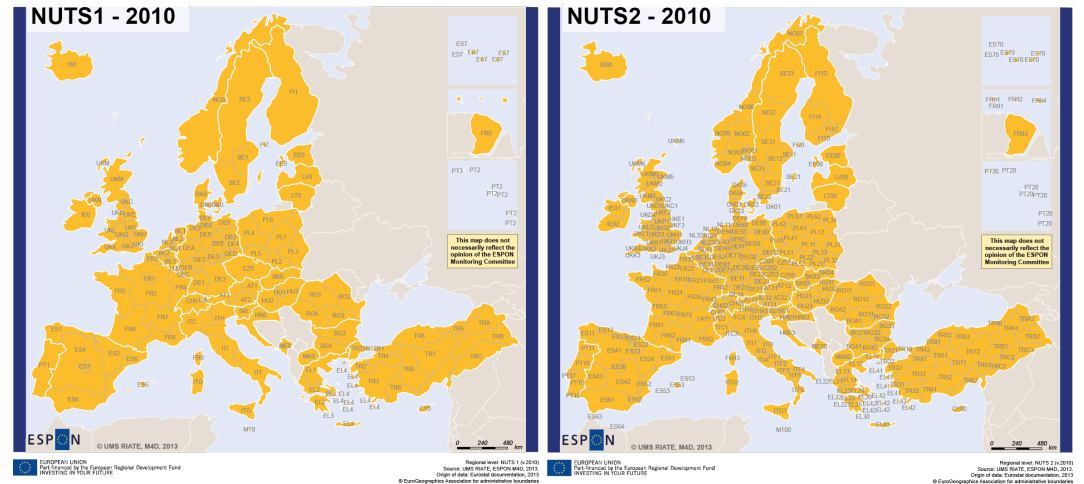
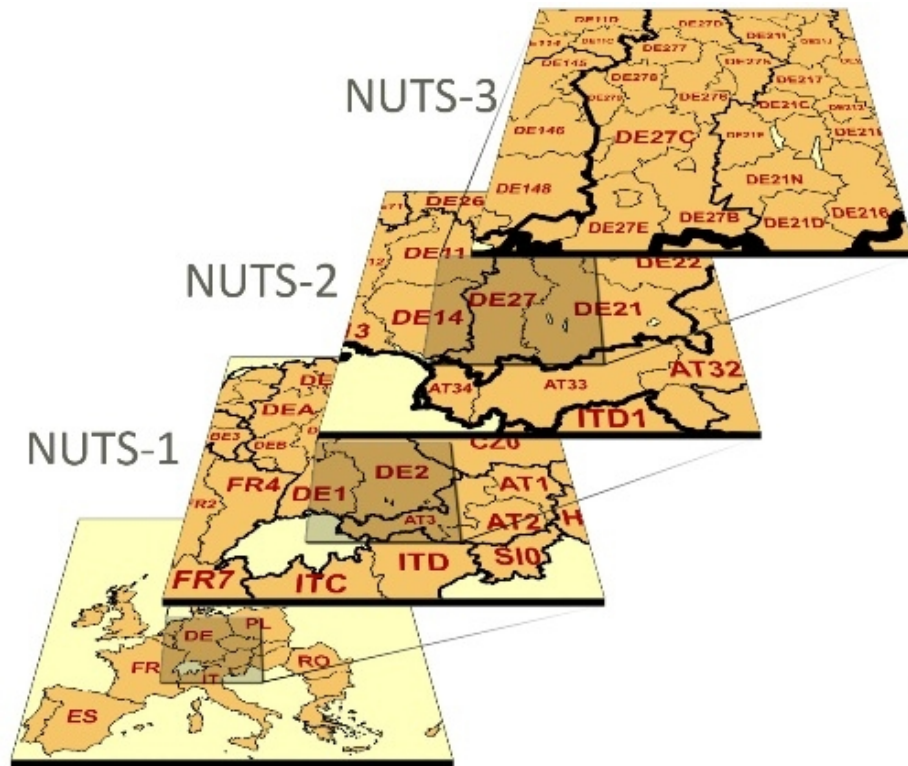
Different maps  
& cartographical  
messages

Wealth



# MAUP (Modifiable Area Unit Problem)

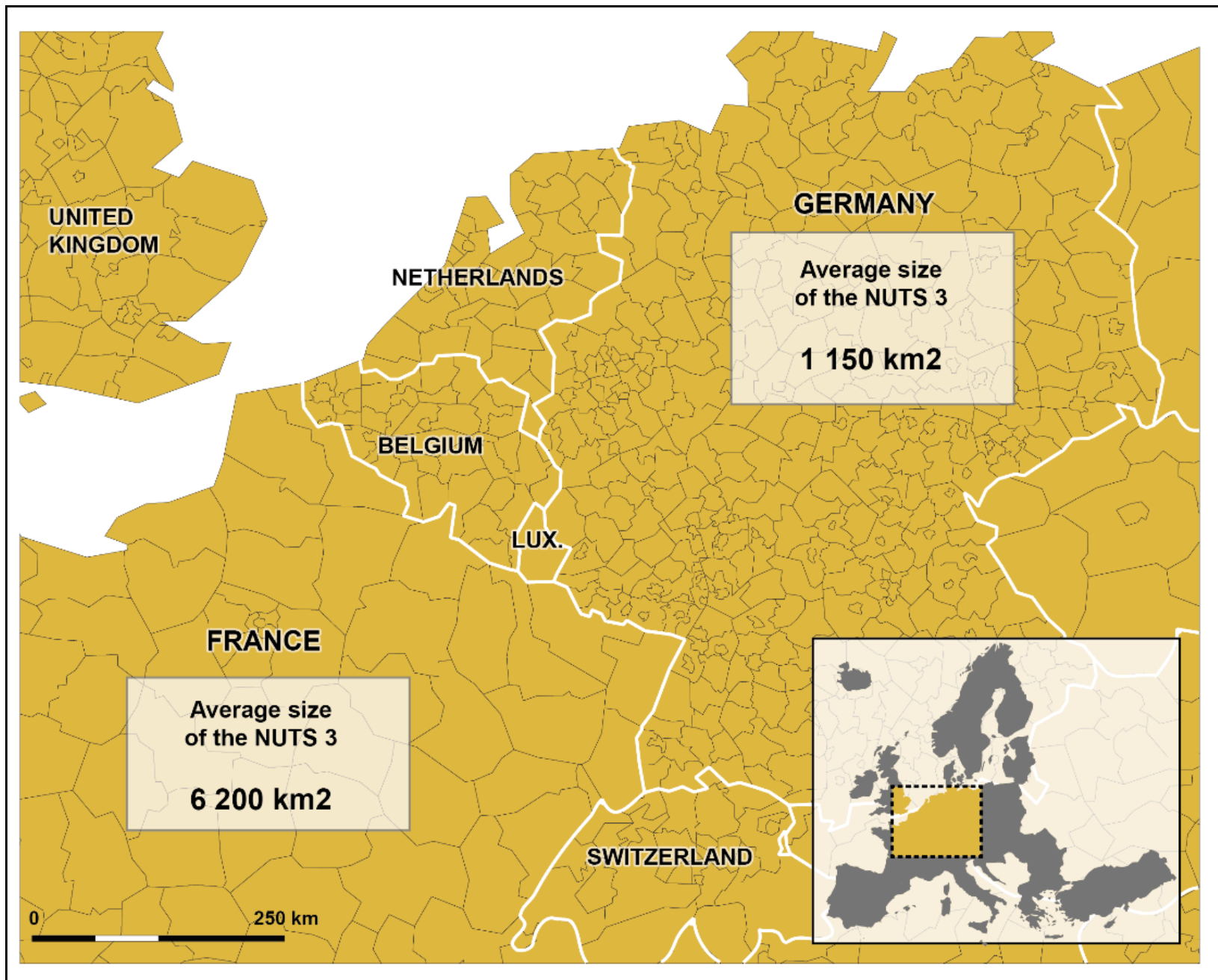
## The MAUP in Europe *The NUTS nomenclature*



# MAUP (Modifiable Area Unit Problem)

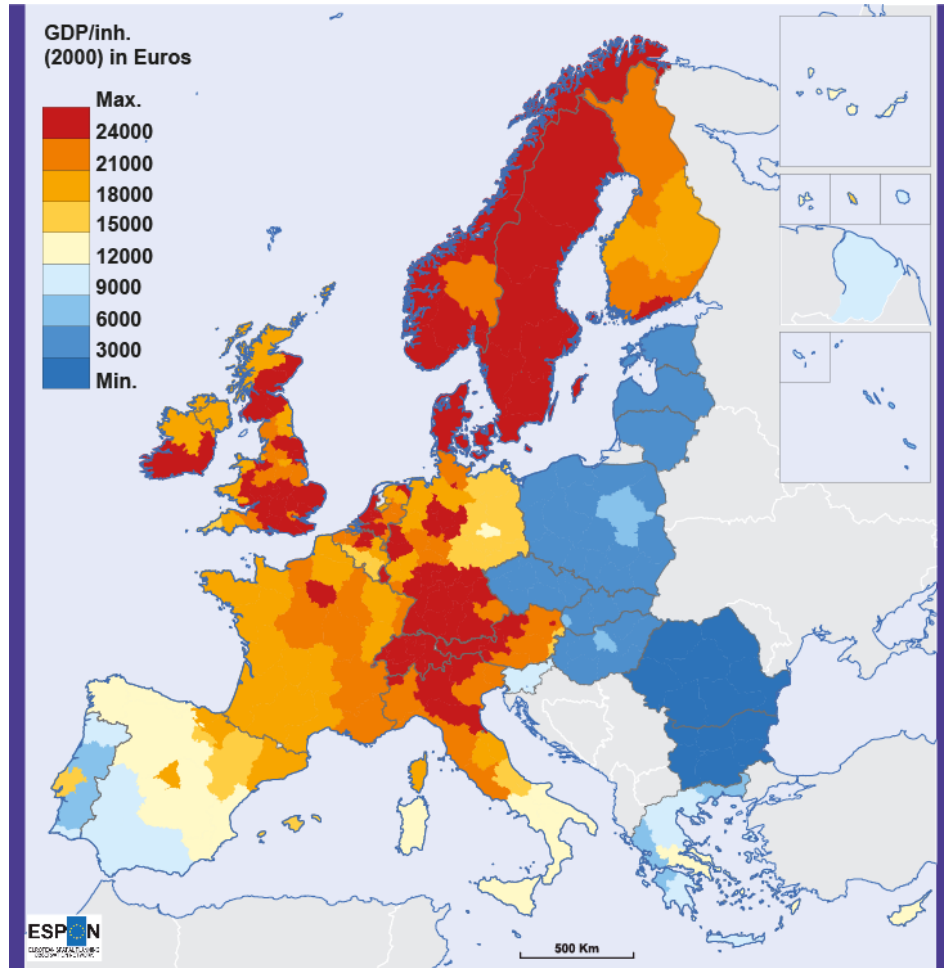
## ► The MAUP in Europe

*The NUTS nomenclature*



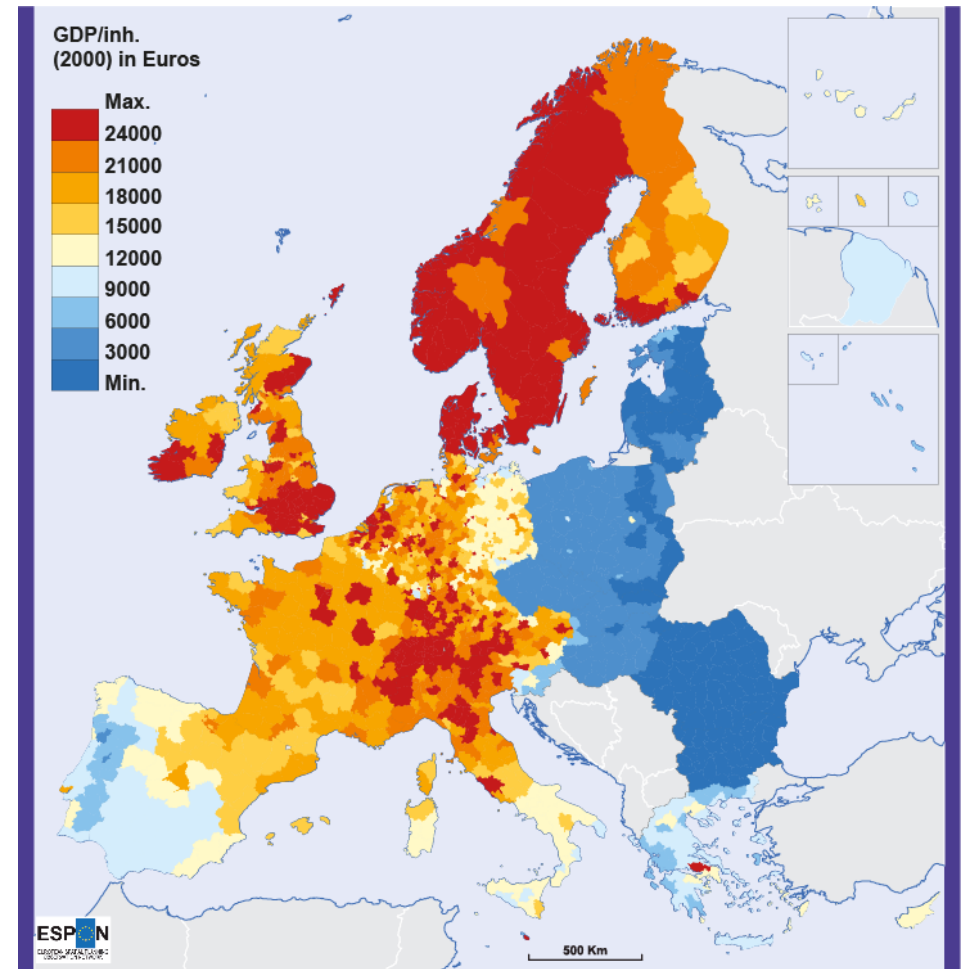
## ► The MAUP in Europe

*GDP per inh. In 2000*



Geographical Base: Eurostat GISCO  
Regional Level: NUTS 3

**NUTS 2**



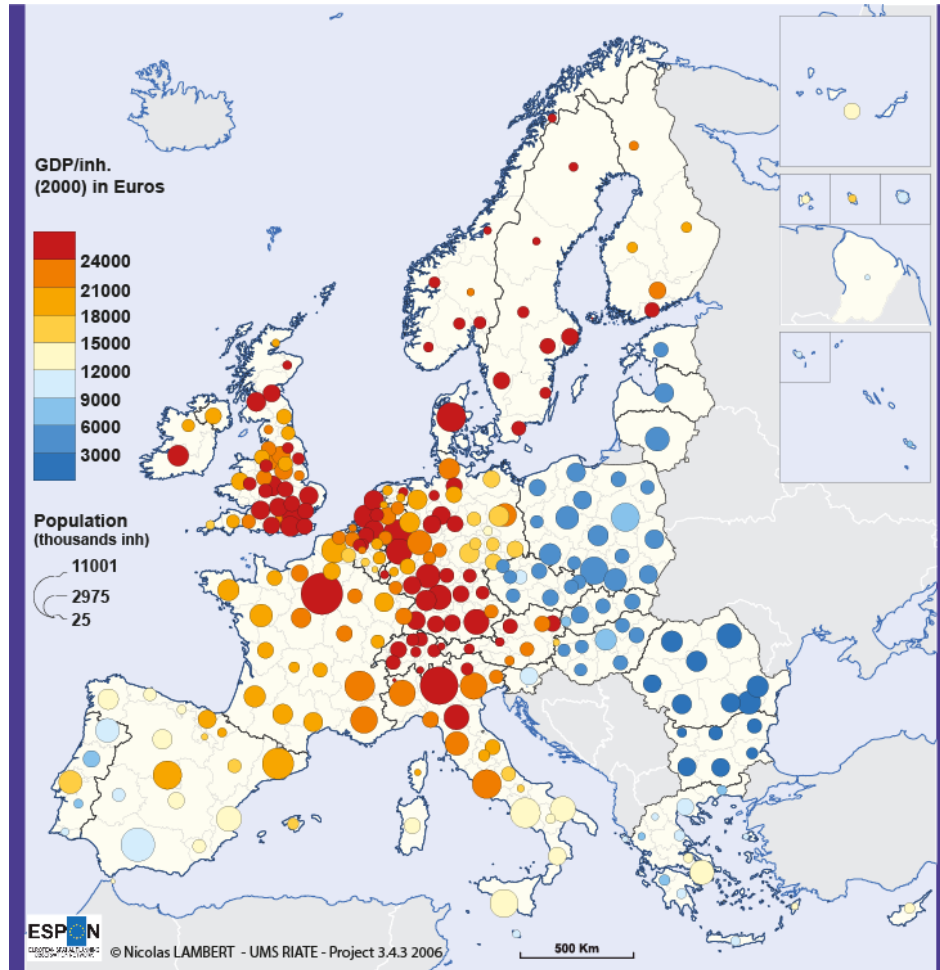
Geographical Base: Eurostat GISCO  
Regional Level: NUTS 3

**NUTS 3**



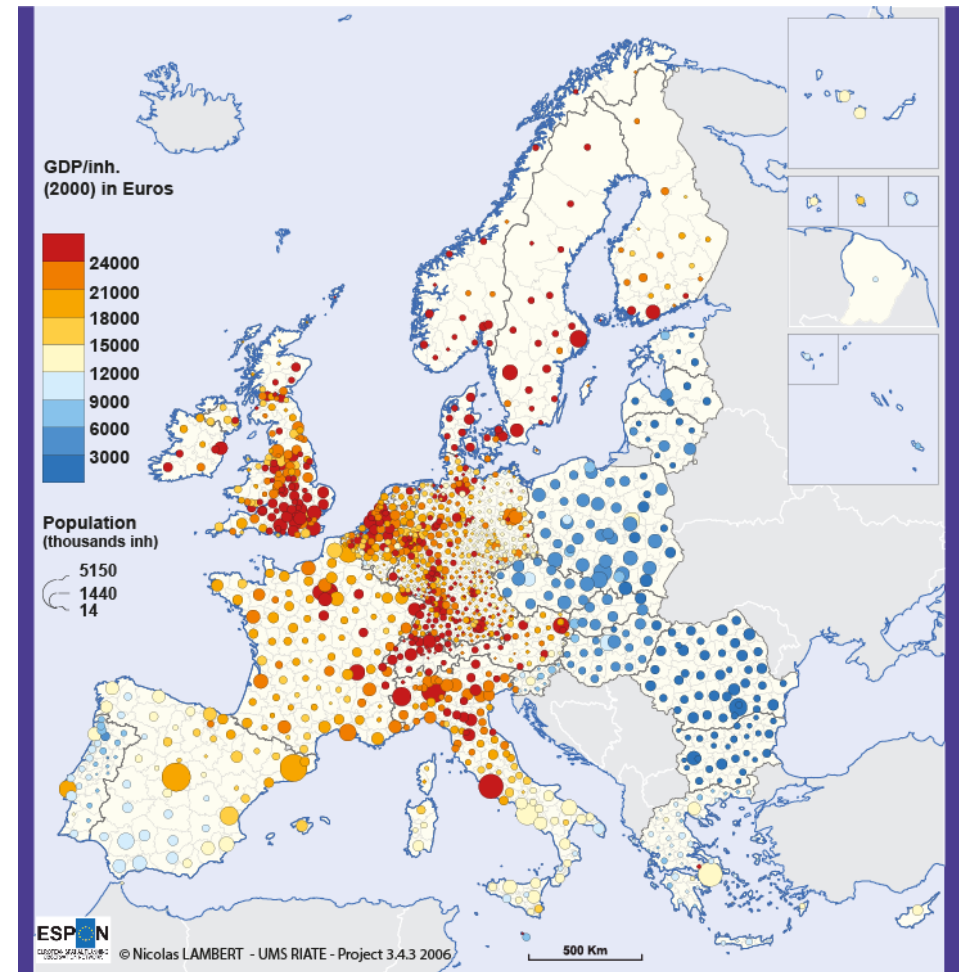
## How to solve it?

*Cartography of ratio and visualisation of denominator*



Geographical Base: Eurostat GISCO  
Regional Level: Nuts 2

**NUTS 2**

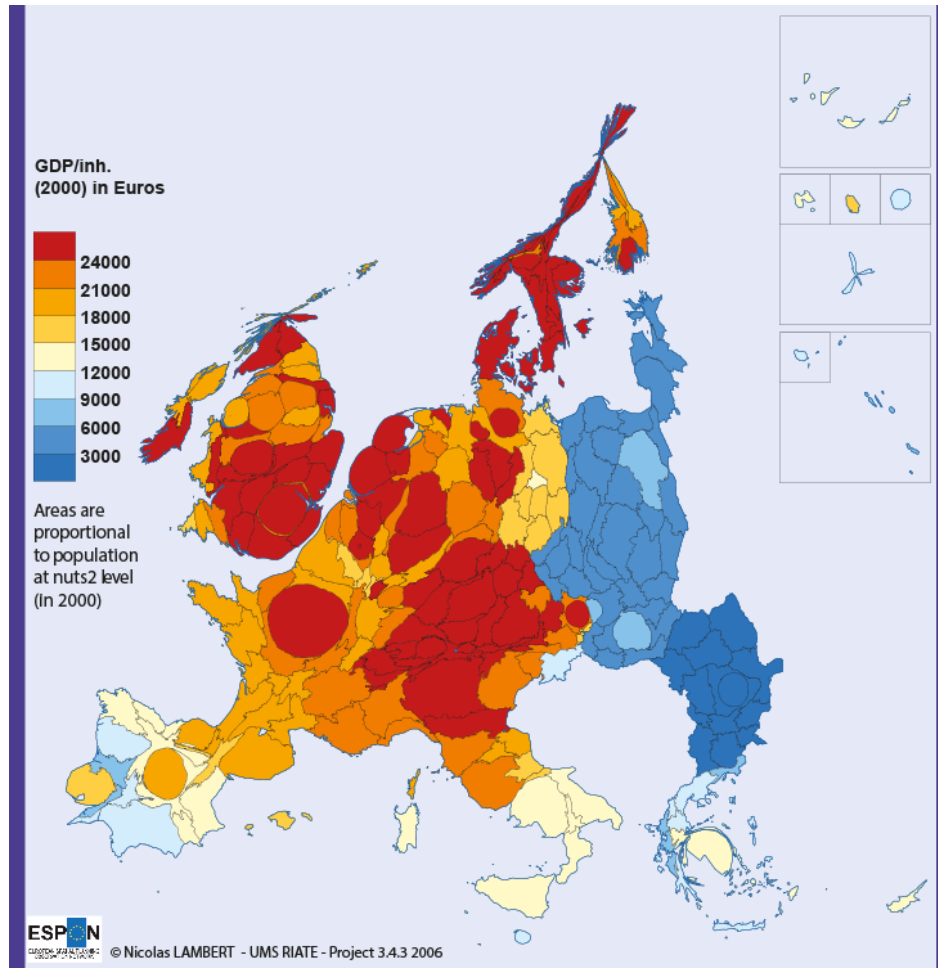


Geographical Base: Eurostat GISCO  
Regional Level: Nuts 2

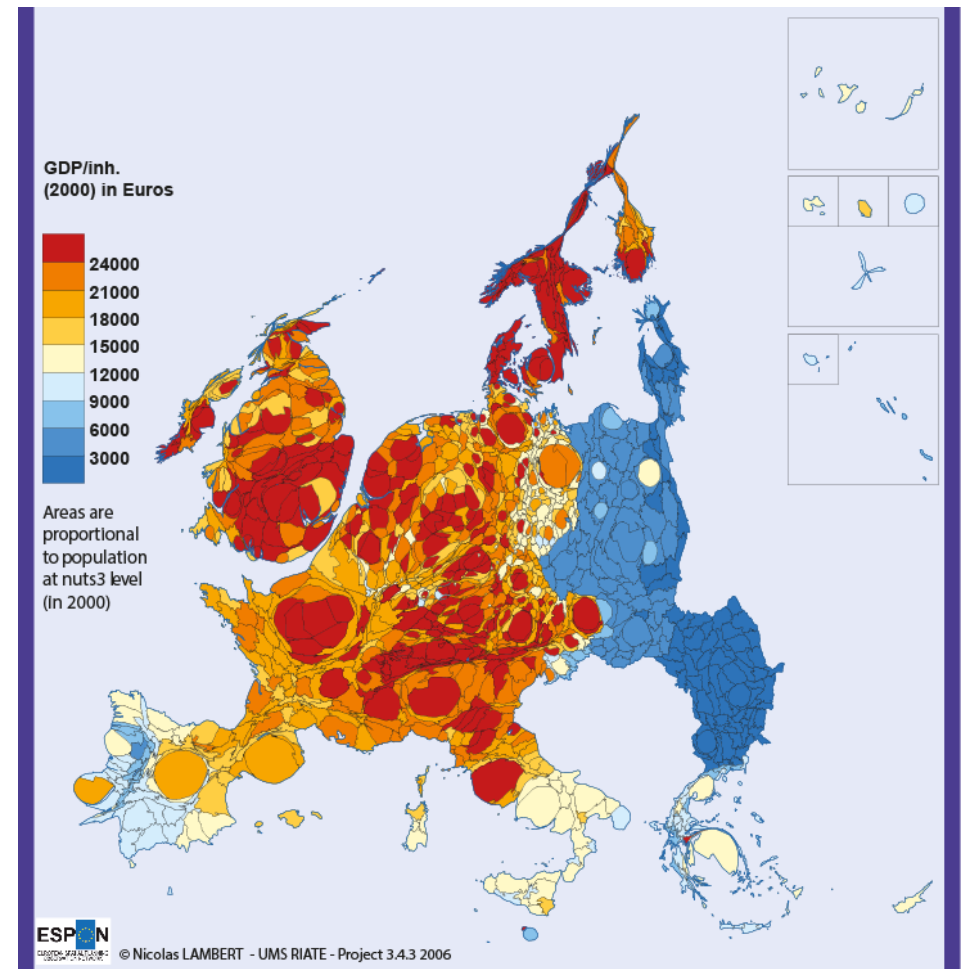
**NUTS 3**

## How to solve it?

*Cartograms as solution to the MAUP*



**NUTS 2**



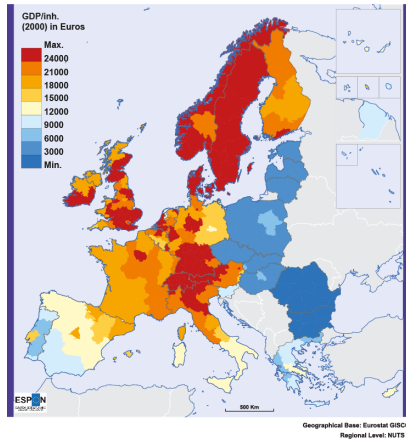
**NUTS 3**

# MAUP (Modifiable Area Unit Problem)

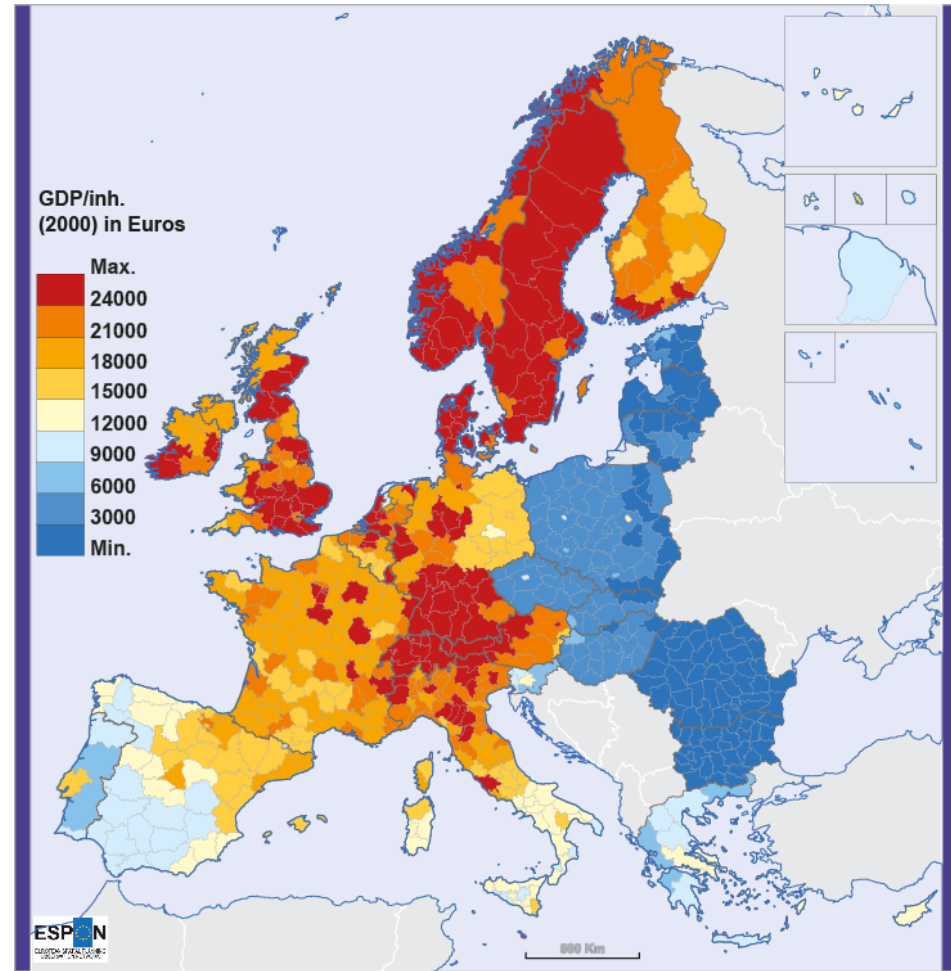
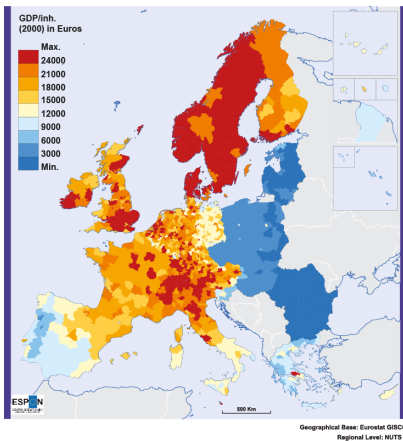
## How to solve it?

*Aggregation of administrative boundaries (e.g NUTS 2-3)*

NUTS 2



NUTS 3

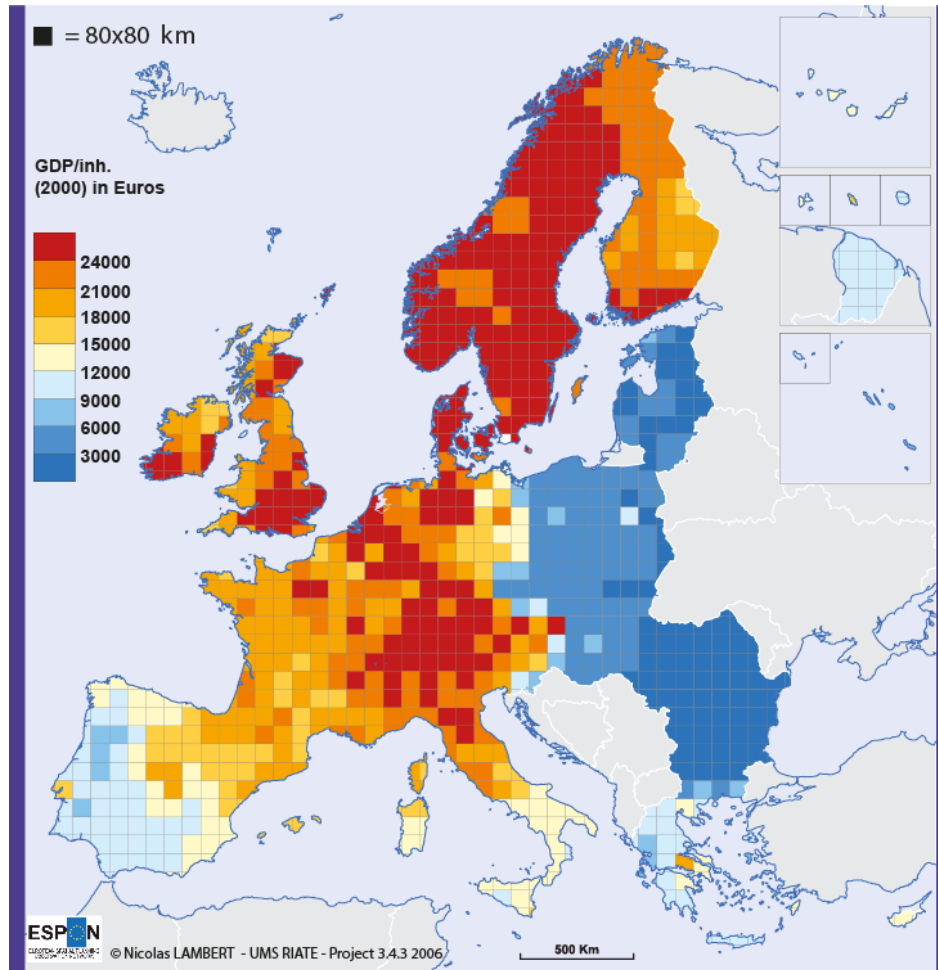


NUTS 2/3 (mix)

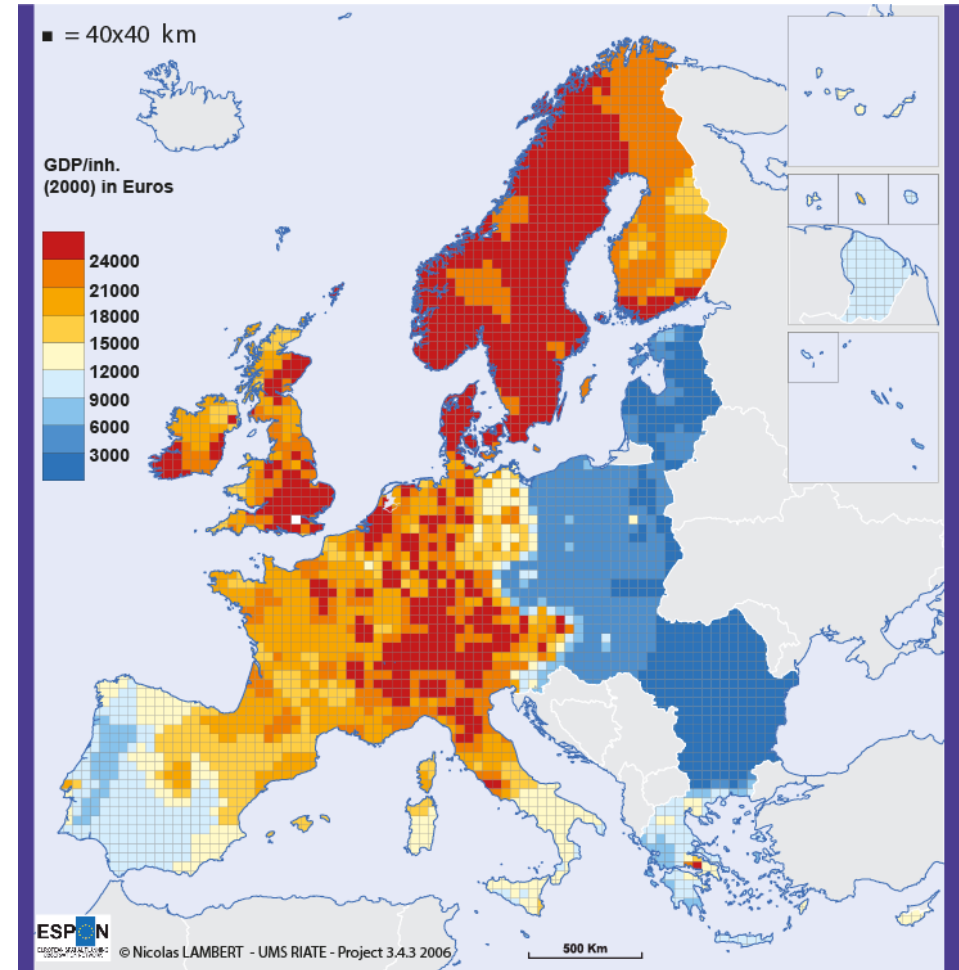
Geographical Base: Eurostat GISCO  
Regional Level: NUTS 3

## How to solve it?

*Gridding methods*



80x80 km

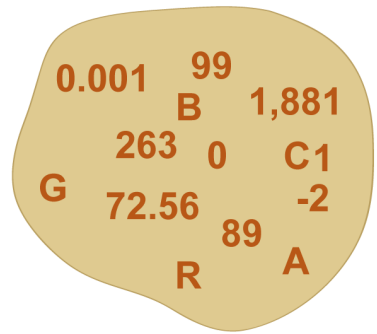


40x40 km

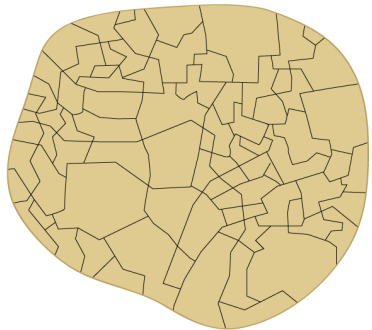


# MAUP (Modifiable Area Unit Problem)

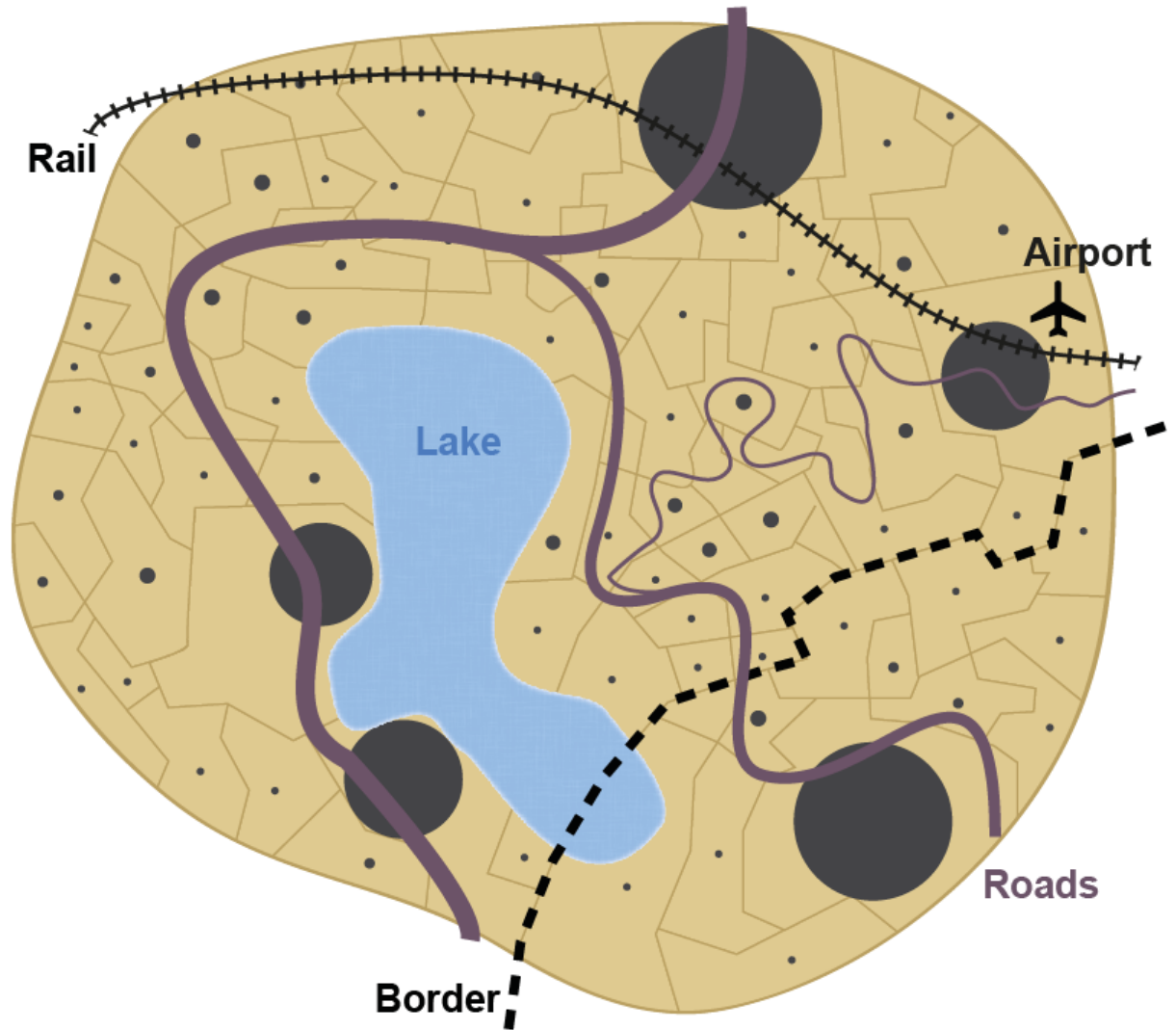
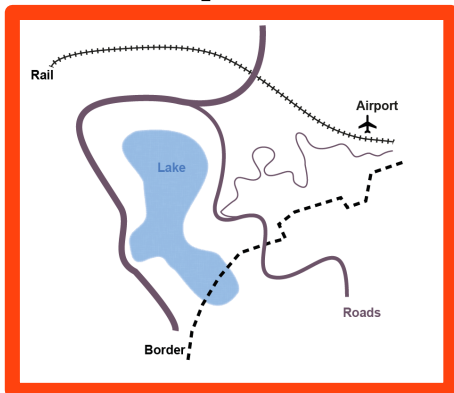
## ► A better approach



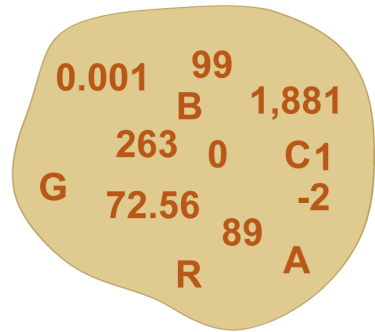
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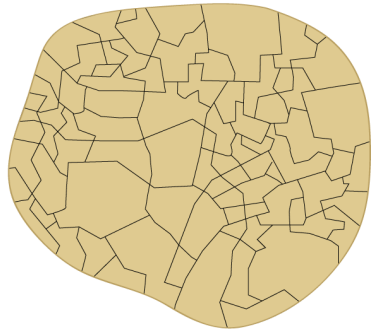
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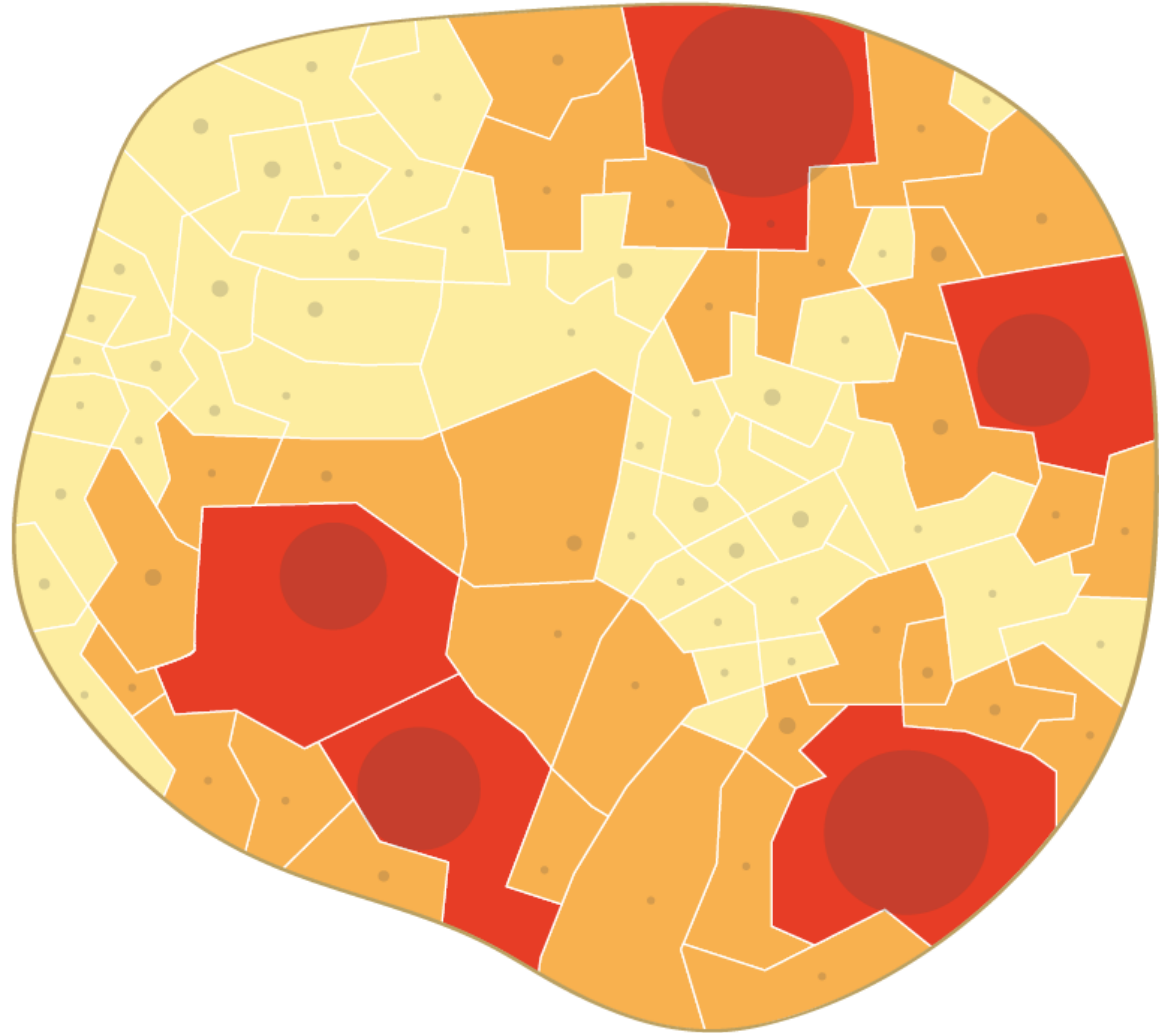
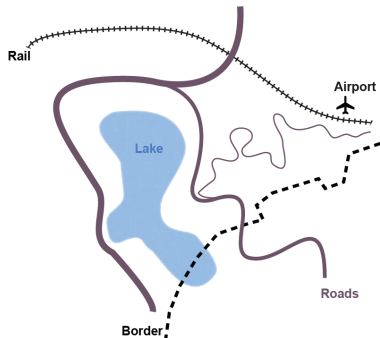
## ► spatial interaction modeling



+

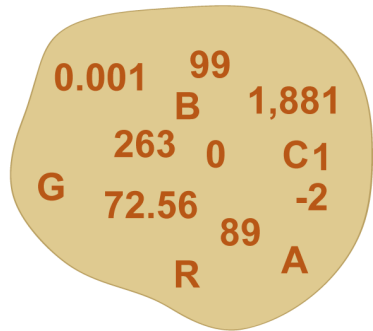


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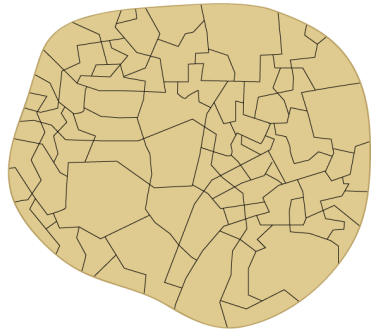


Euclidan distance

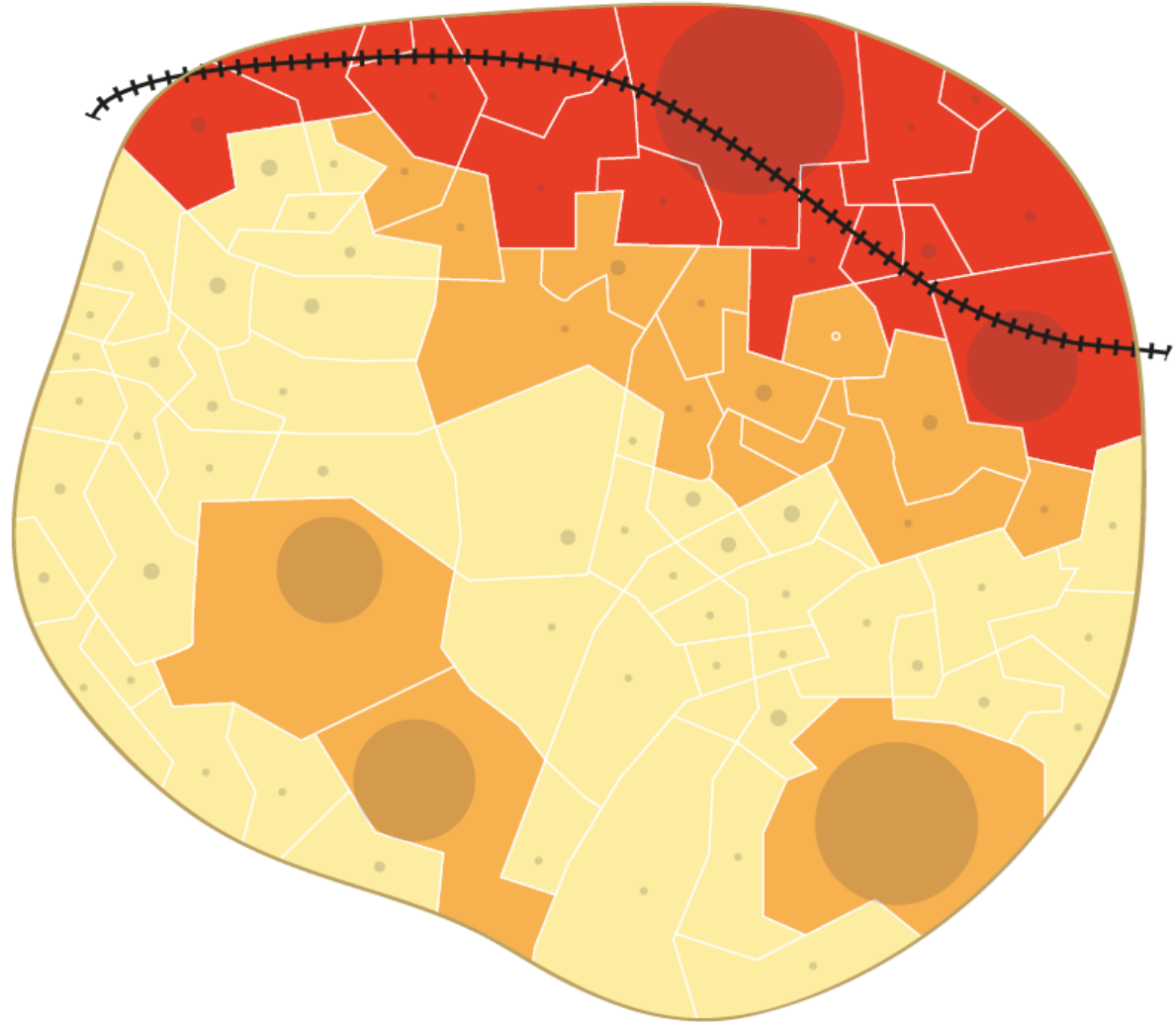
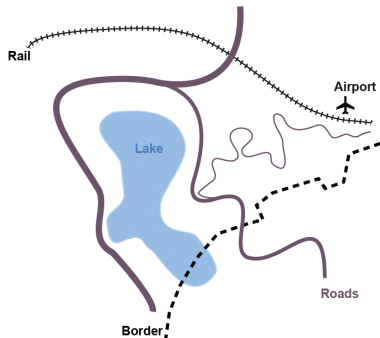
## ► spatial interaction modeling



+

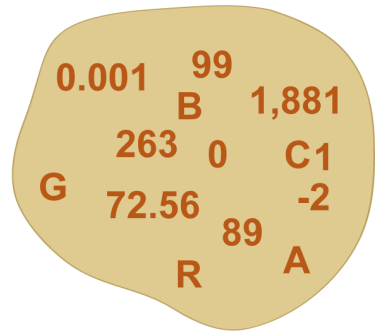


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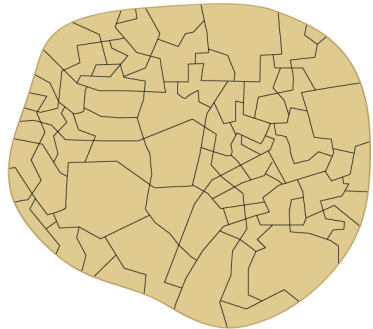


Rail distance

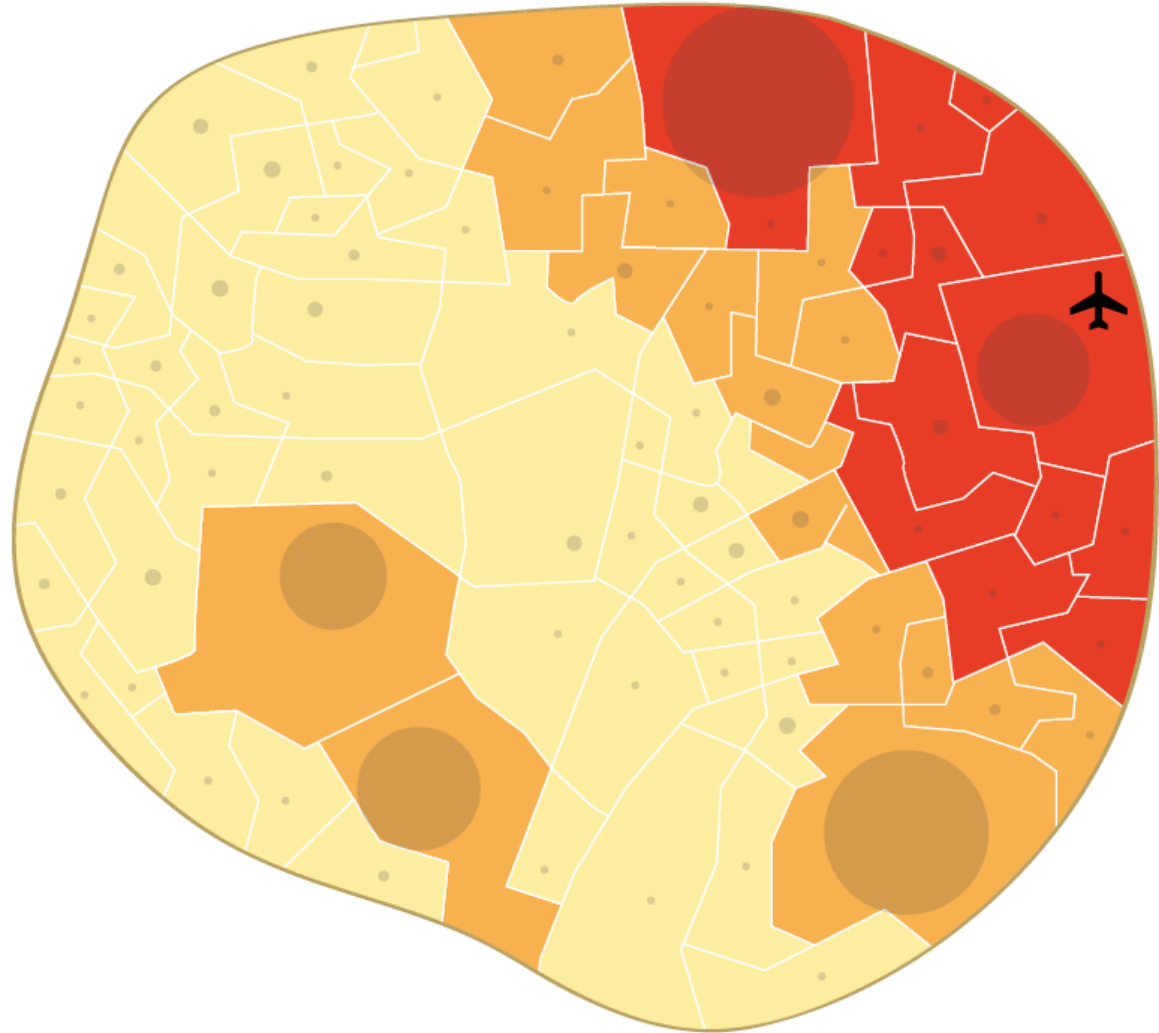
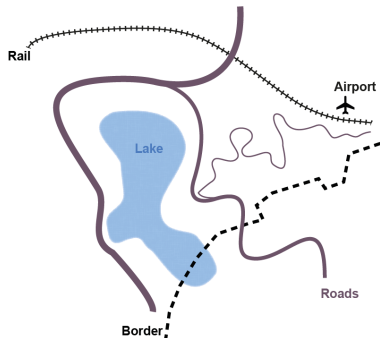
## ► spatial interaction modeling



+

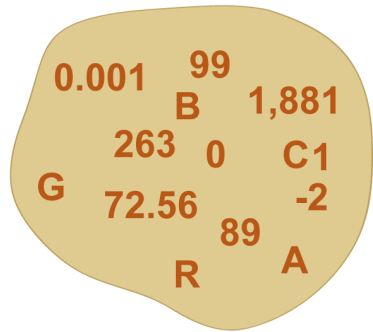


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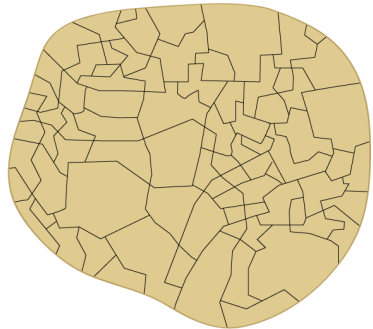


Air distance

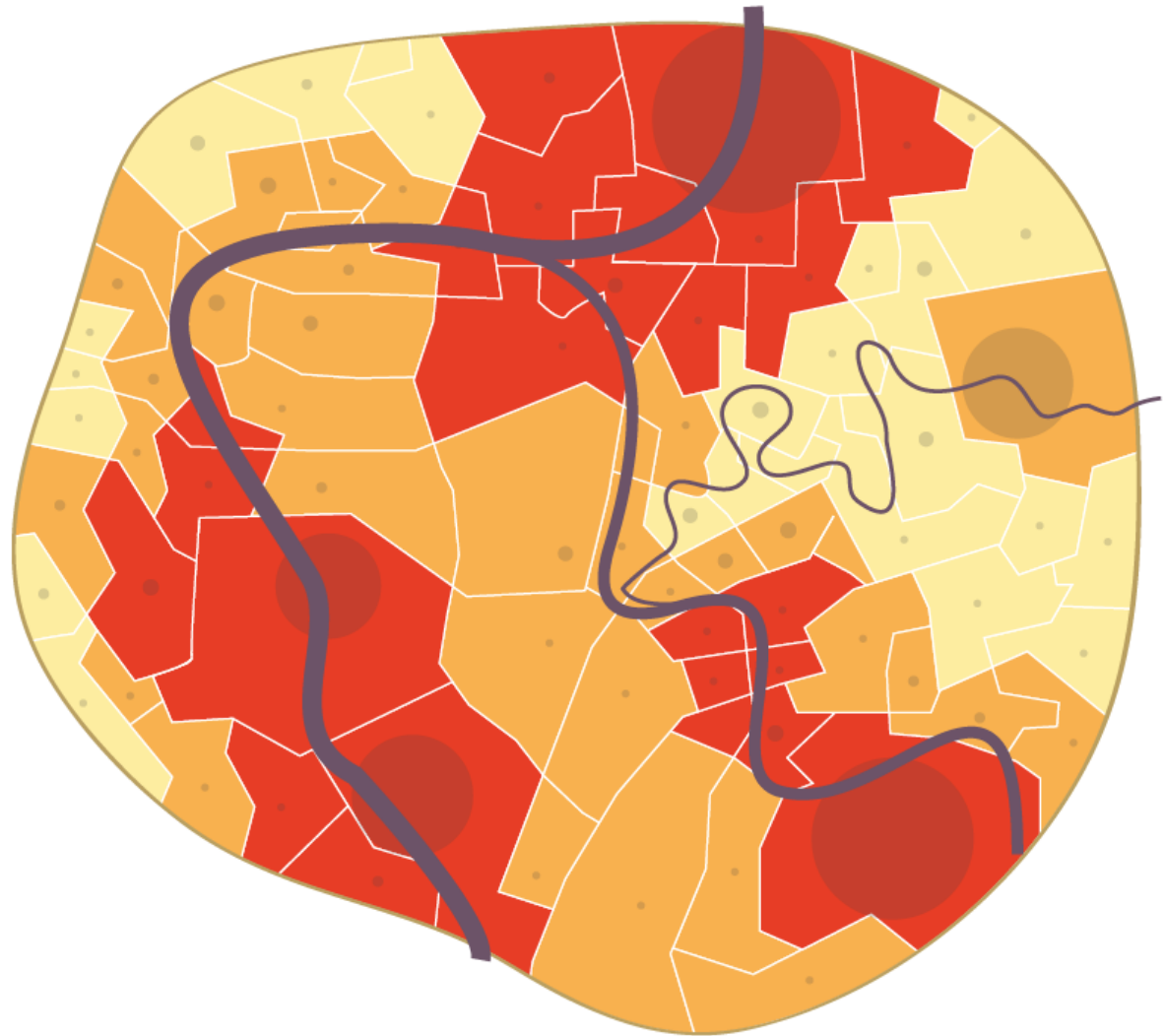
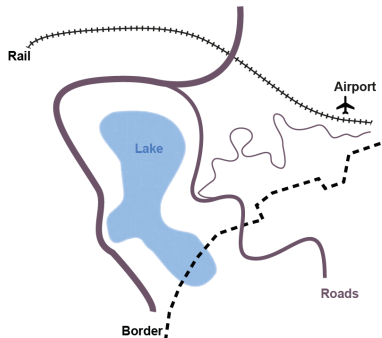
## ► spatial interaction modeling



+

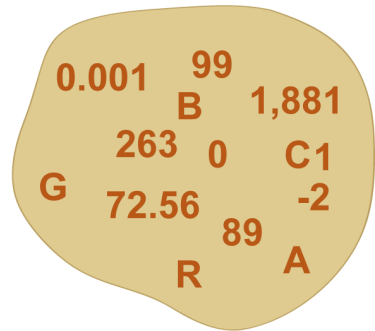


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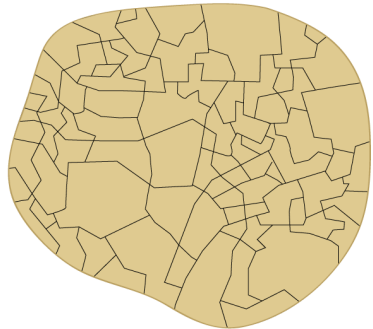


Road distance

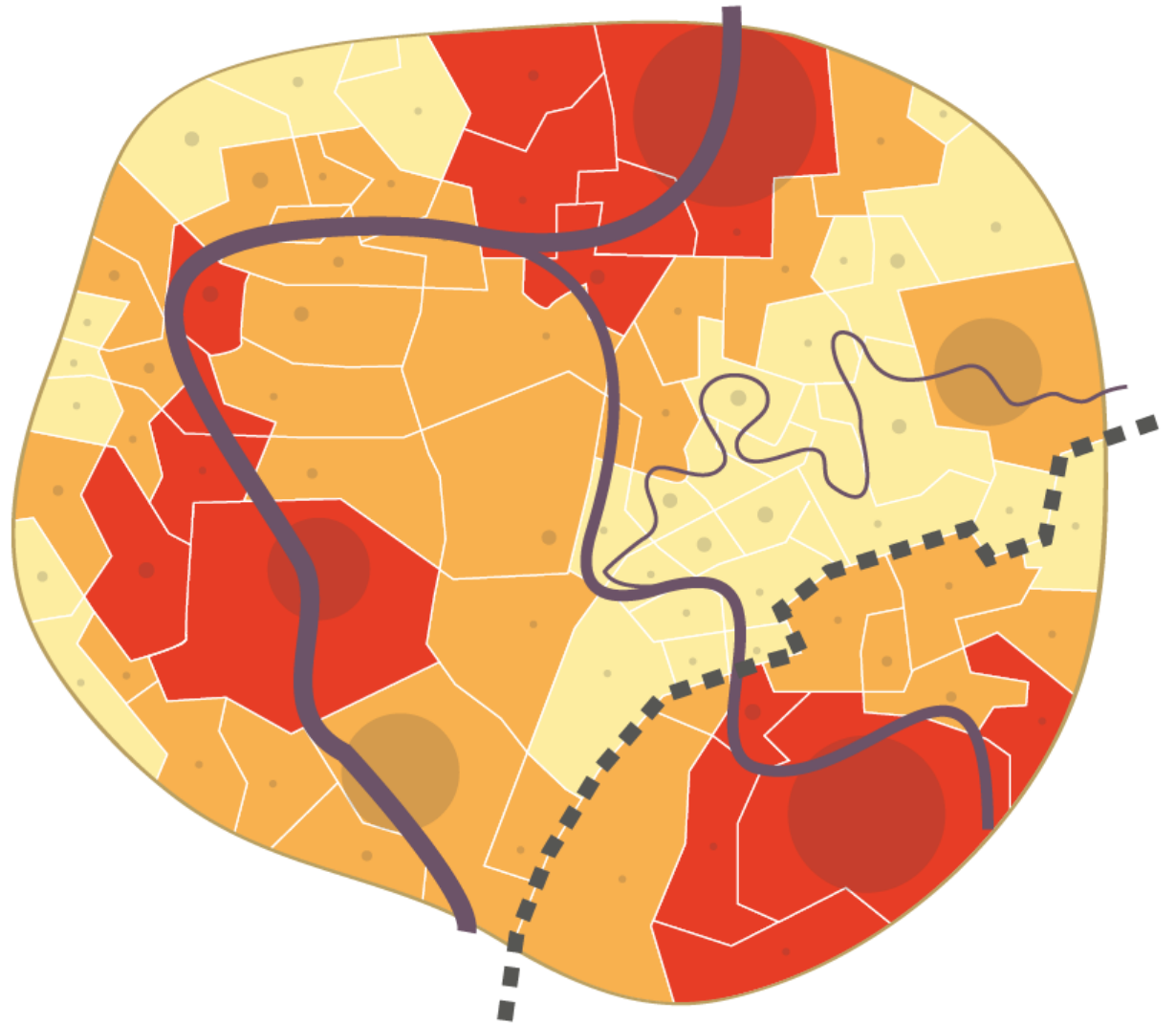
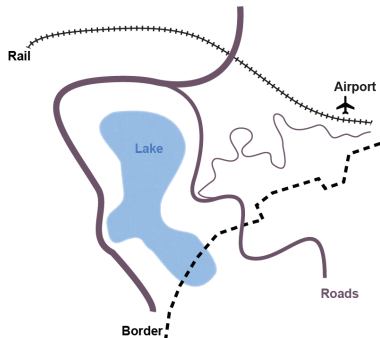
## ► spatial interaction modeling



+



+



Road distance + border

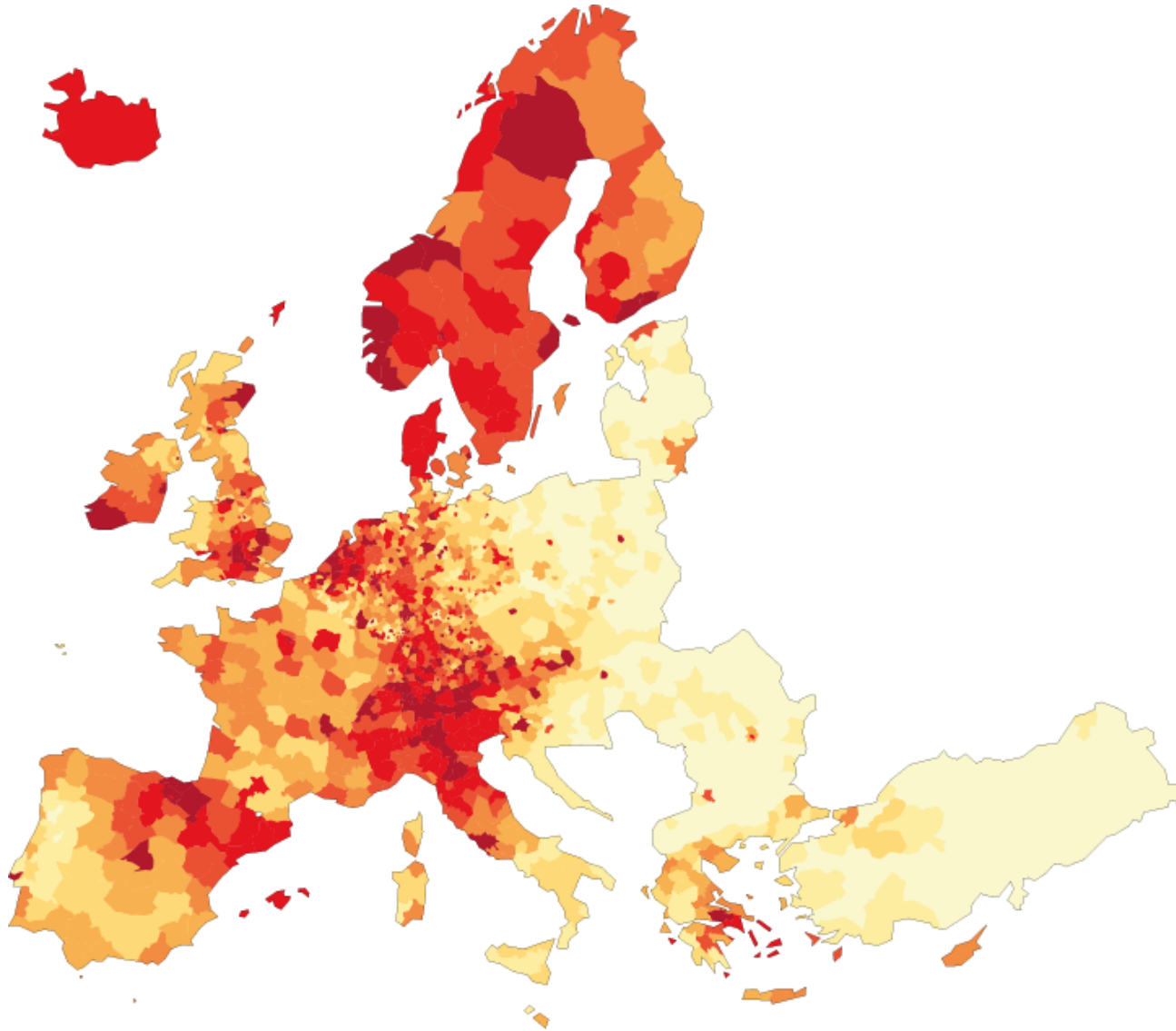
## ► spatial interaction modeling

Stewart model (potential access, gravitational potential or gravitational accessibility)

$$A_i = \sum_{j=1}^n O_j f(d_{ij})$$

- $A_i$  is the potential at  $i$
- $O_j$  is the stock of population at  $j$
- $f(d_{ij})$  is a negative function of the distance between  $i$  and  $j$ , mainly of the power or the exponential form.

## ► Enhancing spatial patterns



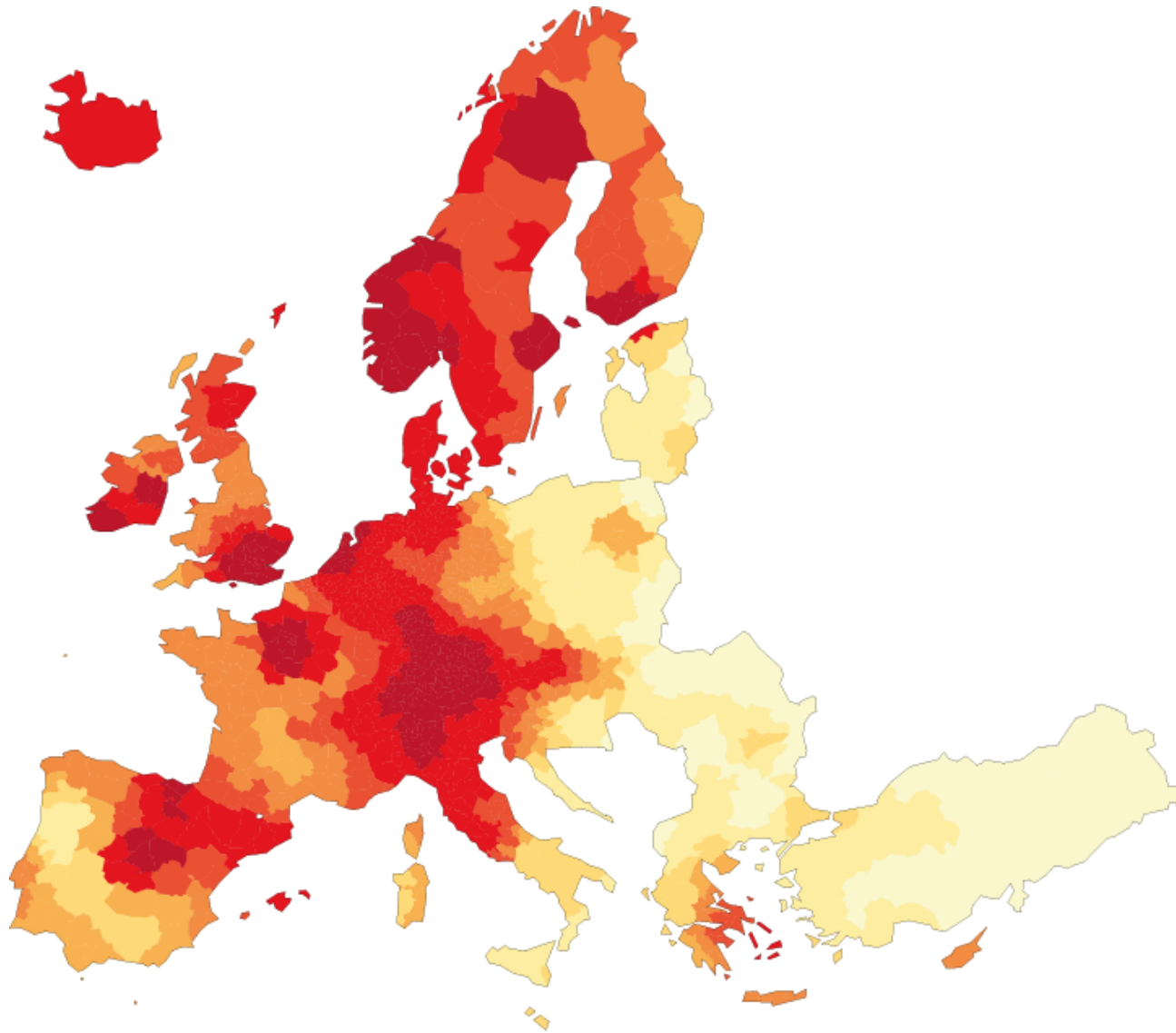
Raw data (*GDP per inh.*)



Raw basemap



## ► Enhancing spatial patterns

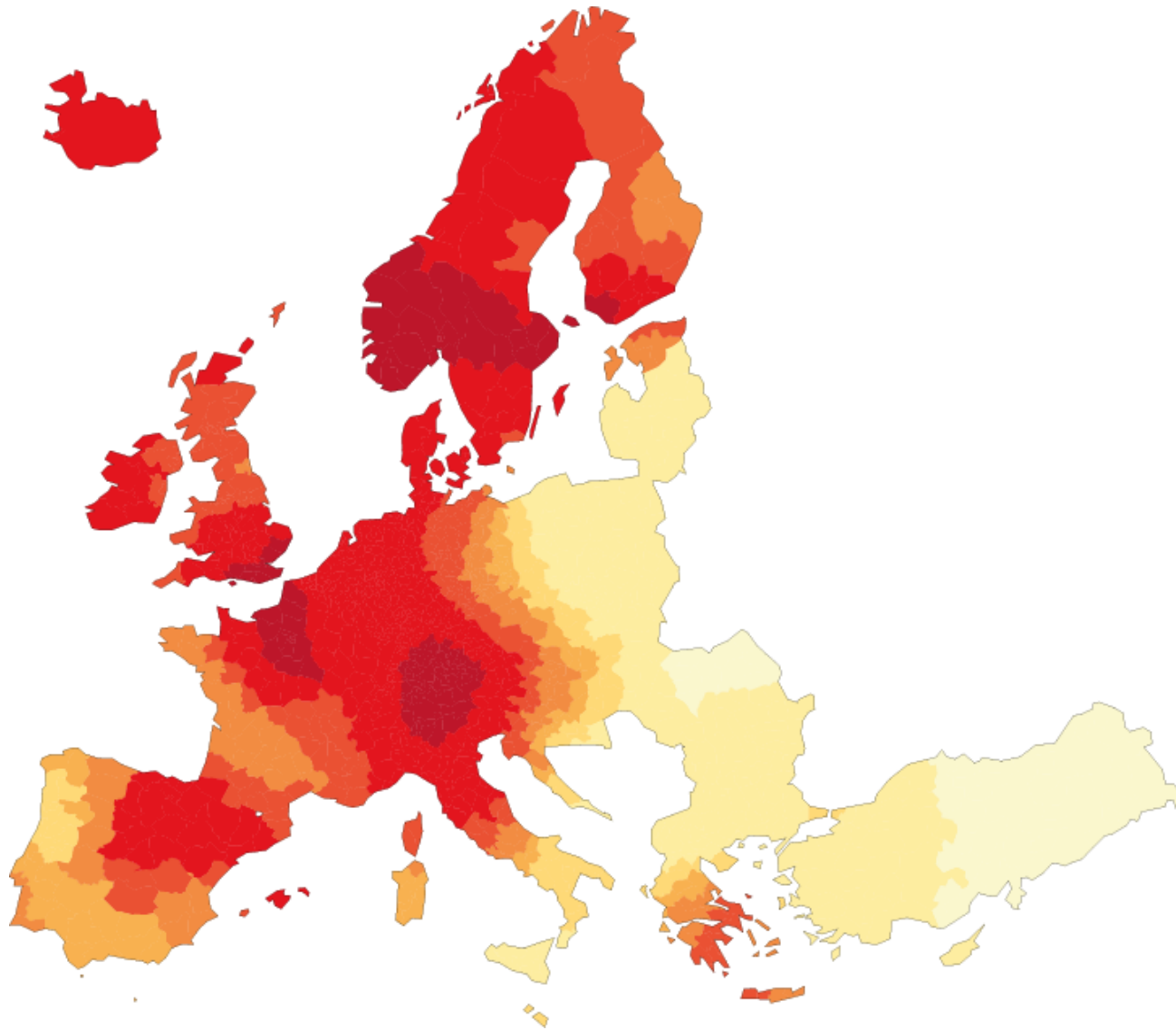


**Semantic simplification (100km)**



**Geometric generalisation  
(+)**

## ► Enhancing spatial patterns

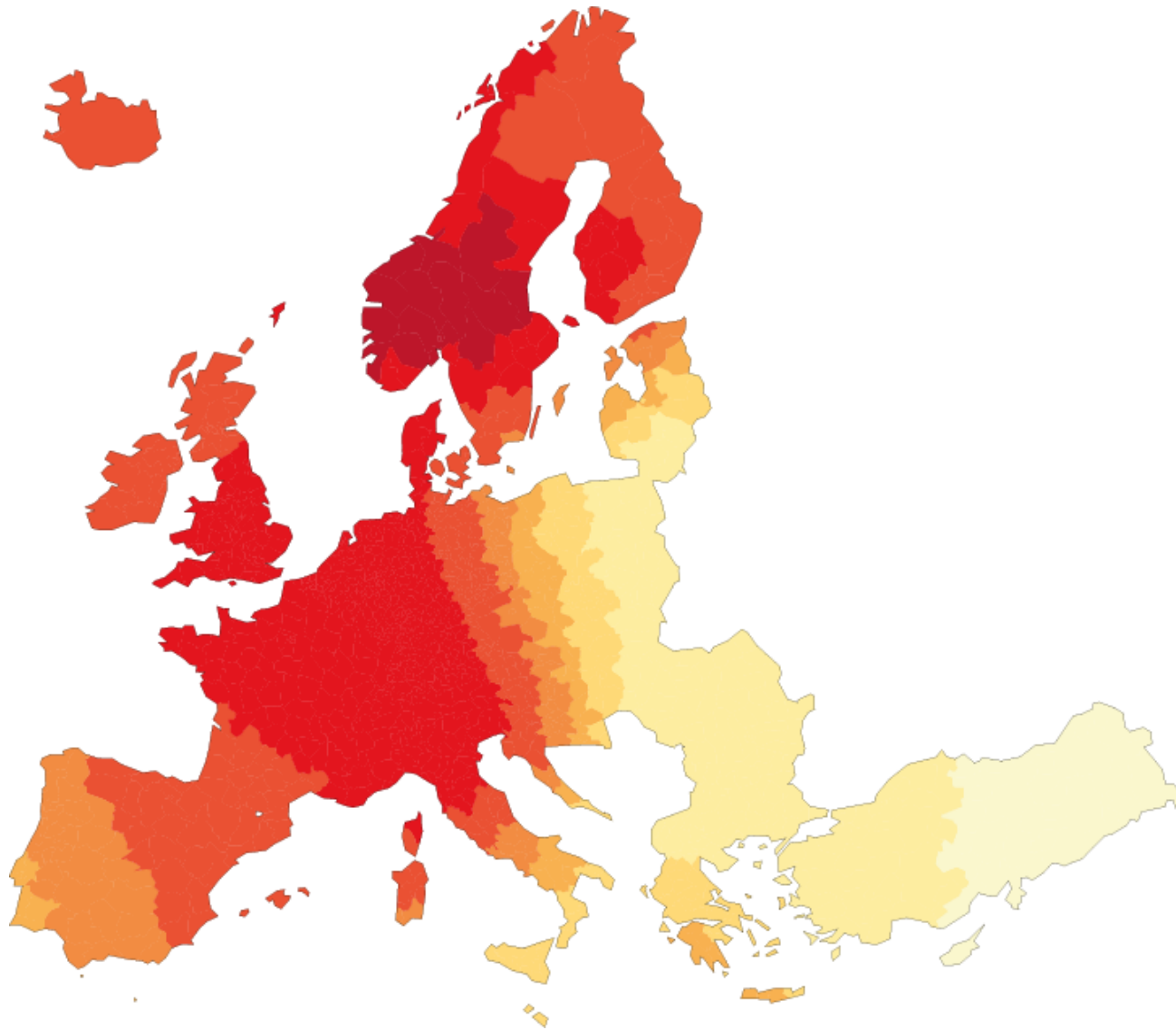


**Semantic simplification (200km)**

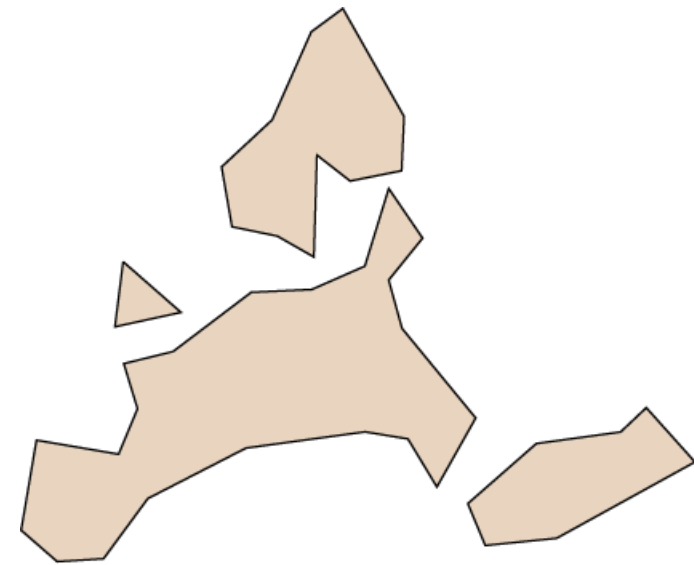


**Geometric generalisation  
(++)**

## ► Enhancing spatial patterns



**Semantic simplification (400km)**



**Geometric generalisation  
(+++)**

## ► Automatic computation and mapping



**A free software environment for statistical computing and graphics.**

**Extended by a lot of community-developed external libraries (packages)**

- *SpatialPosition* package created to compute gravitational potential (Stewart potentials)
- Various mapping packages

# A European Tool (FIT)

**ESPON**

Home Inspire policy making by territorial evidence

Programme Projects Calls Events **Tools and Maps** Publications Press

Database Portal  
BSR-TeMo  
CityBench  
Data Navigator  
**Functional Indicators Tool**  
HyperAtlas  
Mapping Guide  
Online MapFinder  
Online Mapping tool  
Regional Typologies  
TIA Tool  
ESPON 2006 Tools

**Functional Indicators Tool**

The Functional Indicator Tool (FIT) is a practical and user-friendly application for producing and displaying innovative indicators related to the effects of transportation networks on accessibility and the territorial development.

The FIT allows policymakers and practitioners at all administrative levels, together with the general public, to compute total population, active population and Gross Domestic Product (GDP) within defined time distances of NUTS 2 and NUTS 3 regions using spatial interaction modelling and different modes of transport. Users can also explore functional information for specific regions; compare and benchmark regions in the EU, and analyse the impacts of borders on territorial development. Charts, maps and data can be easily downloaded in various formats for further analysis and use in reports and presentations, as required.

For example, a large internet sales company is seeking a new location in Europe and is seeking optimal location for which to locate. The user in this instance can make use of the FIT functionality to interrogate how much of the EU GDP is within 4 hours drive in order to maximise sales and delivery. Equally, the new employer can investigate the potential workforce with defined time distances by different modes of transport. Furthermore, a regional policymaker can assess the impact of enhanced cross-border cooperation on territorial development and benchmark his or her region with other EU regions. Data and maps for 2001, 2006 and 2011 can be interrogated in order to evaluate trends over time.

The FIT is designed to be easily navigable by non-experts. Help buttons provide short explanations of all FIT together with a glossary of terms.

**Access the ESPON Functional Indicators Tool.**

The Functional Indicator Tool has been created in 2014 by UMS RIATE in the framework of the ESPON 2013 Programme. Data sources are provided by S&W Spiekermann & Wegener, Urban and Regional Research.

FAQ Contact Links Site Map Legal Notice

EUROPEAN UNION  
Part-financed by the European Regional Development Fund  
INVESTING IN YOUR FUTURE

<http://fit.espon.eu/>

**ESPON**

Go to the ESPON Web Site Functional Indicators Tool

Maps My Region Benchmark Help

**Configure your map**

**Indicators** ?  
☐ Active Population  
☒ Gross Domestic Product  
☐ Total Population

**Potential** ?  
☐ 1 hour ☐ 2 hours ☐ 4 hours ☒ 8 hours  
☐ National Borders [OFF]

**Accessibility** ?  
☐ 1 % ☐ 5 % ☐ 10 %

**Mode** ?  
☒ Road  
☐ Rail  
☐ Air  
☐ Multimodal

**Time** ?  
☐ 2001 ☐ 2006 ☒ 2011

**Interpretation Key**

This map shows the amount of gross domestic product reachable in 8 hours by road in 2011.

**Example**

In Moselle, there is a potential of 4644000 millions of euros reachable in 8 hours

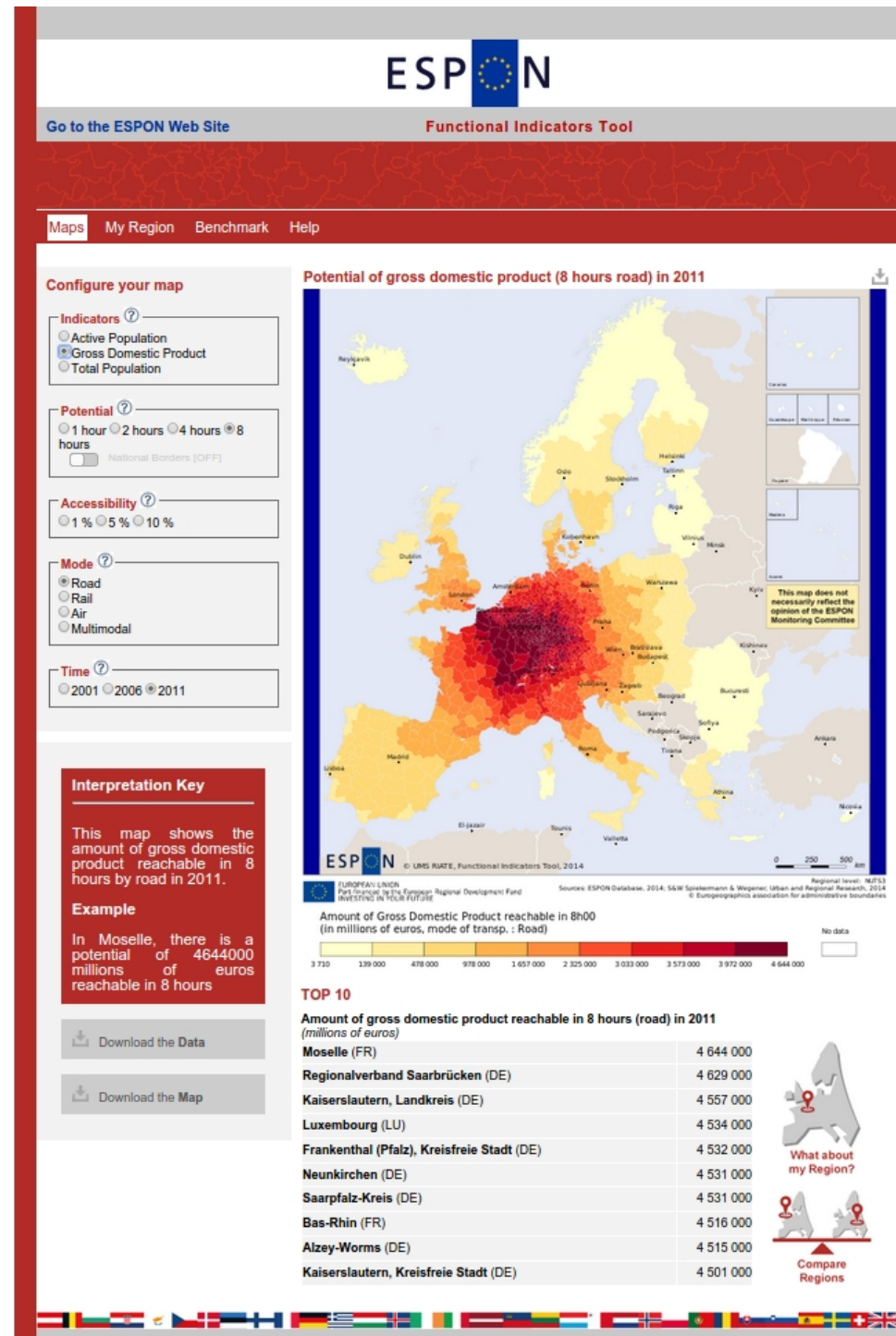
**TOP 10**

Amount of gross domestic product reachable in 8 hours (road) in 2011 (millions of euros)

Moselle (FR)	4 644 000
Regionalverband Saarbrücken (DE)	4 629 000
Kaiserslautern, Landkreis (DE)	4 557 000
Luxembourg (LU)	4 534 000
Frankenthal (Pfalz), Kreisfreie Stadt (DE)	4 532 000
Neunkirchen (DE)	4 531 000
Saarpfalz-Kreis (DE)	4 531 000
Bas-Rhin (FR)	4 516 000
Alzey-Worms (DE)	4 515 000
Kaiserslautern, Kreisfreie Stadt (DE)	4 501 000

What about my Region?  
Compare Regions

# A European Tool (FIT)



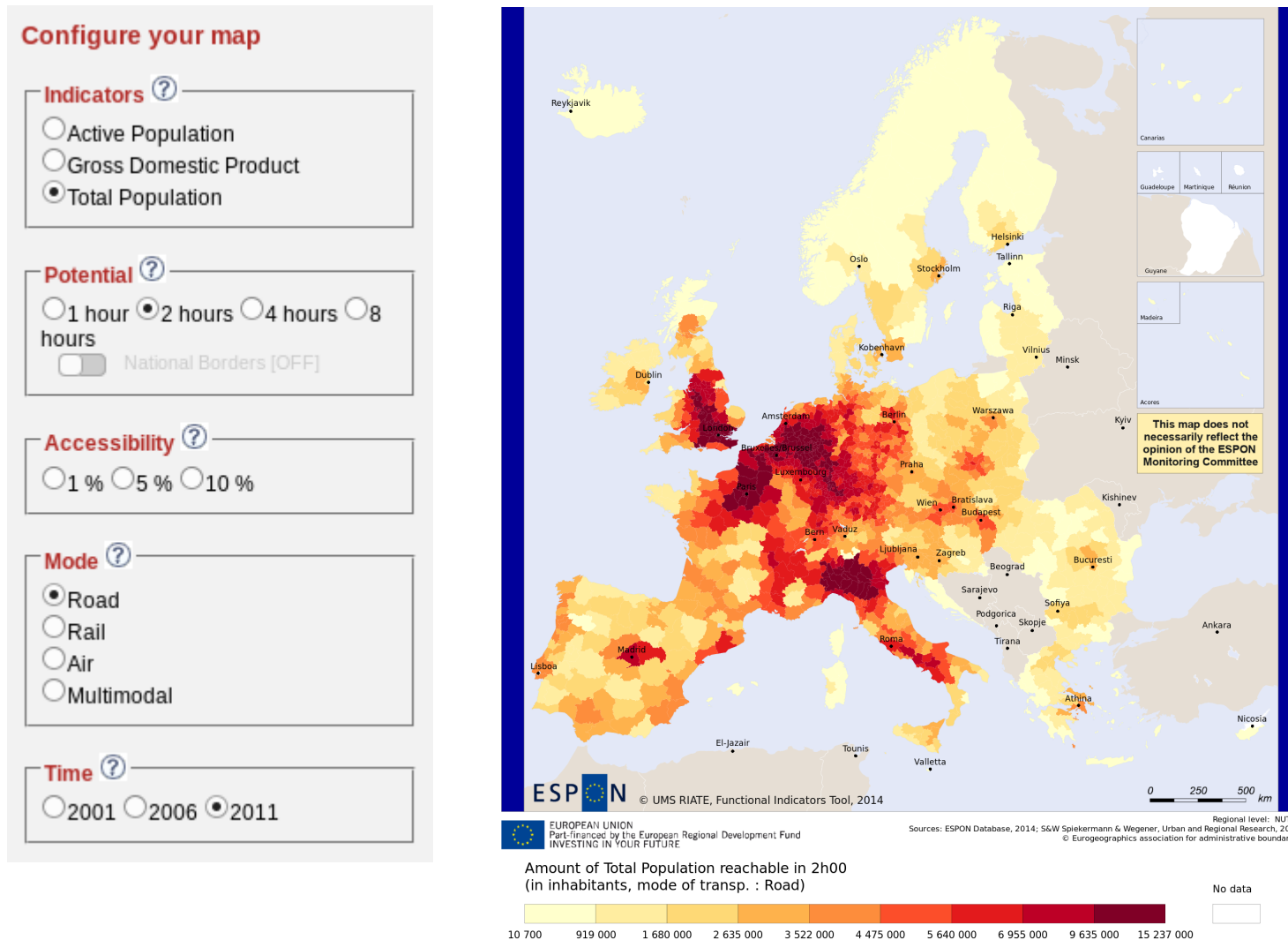

## ► User Case

*Choosing an optimal location: the EU parliament visitor's centers*

- Close to a minimum number of 6 000 000 inhabitants
- In a capital region far from London, Brussels and Paris
- Reachable within 2 hours by road



## User Case



### Interpretation Key

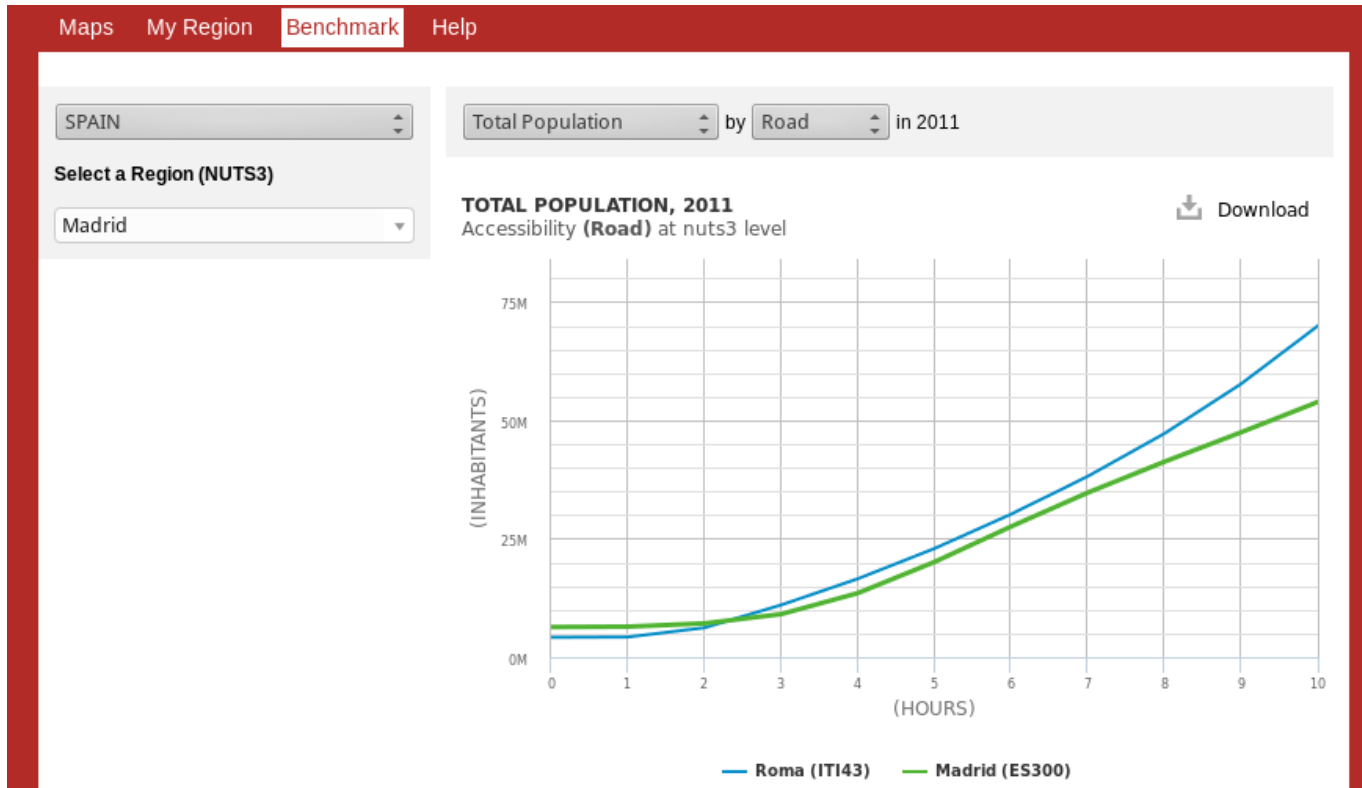
This map shows the amount of total population reachable in 2 hours by road in 2011.

### Example

In Duisburg, Kreisfreie Stadt, there is a potential of 15237000 inhabitants reachable in 2 hours



## User Case



## User Case

amount\_of\_total\_population\_reachable\_in\_2\_hours\_by\_road\_in\_2011.csv - LibreOffice Calc

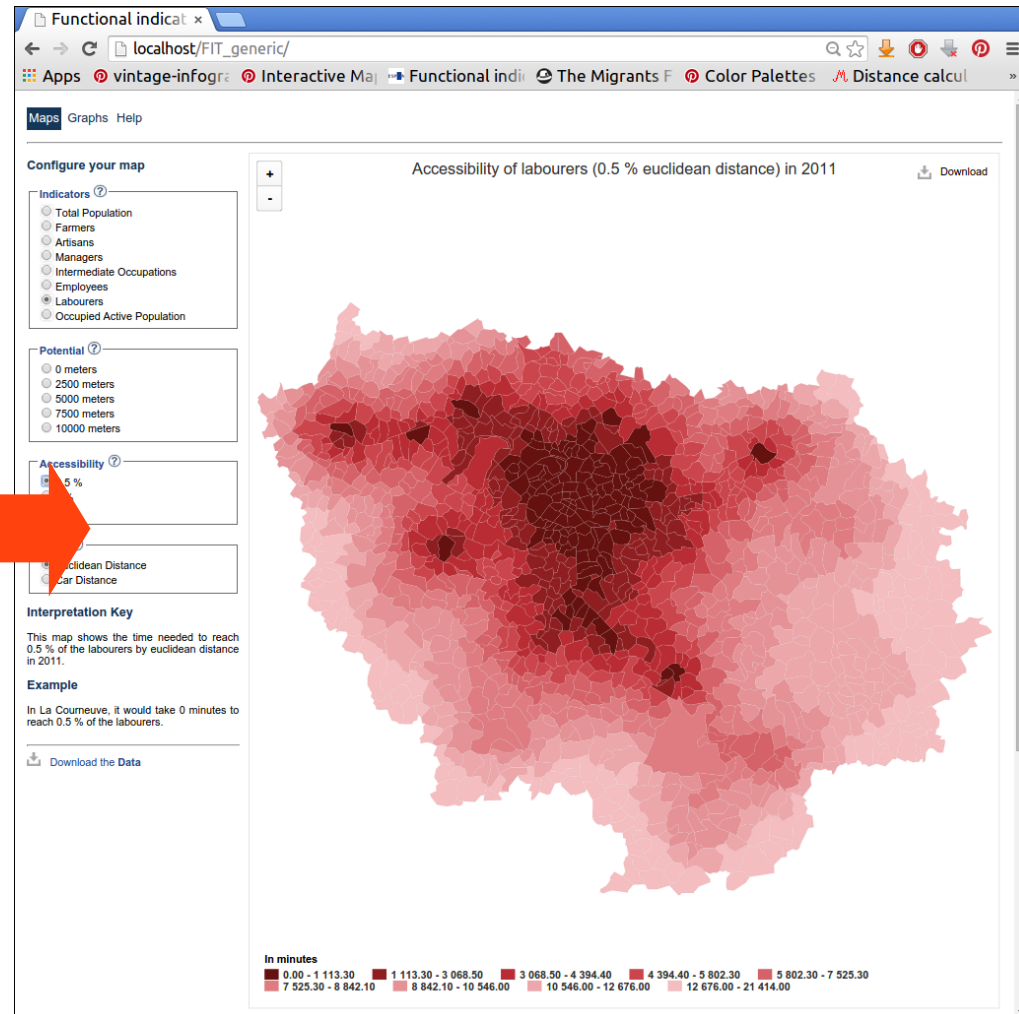
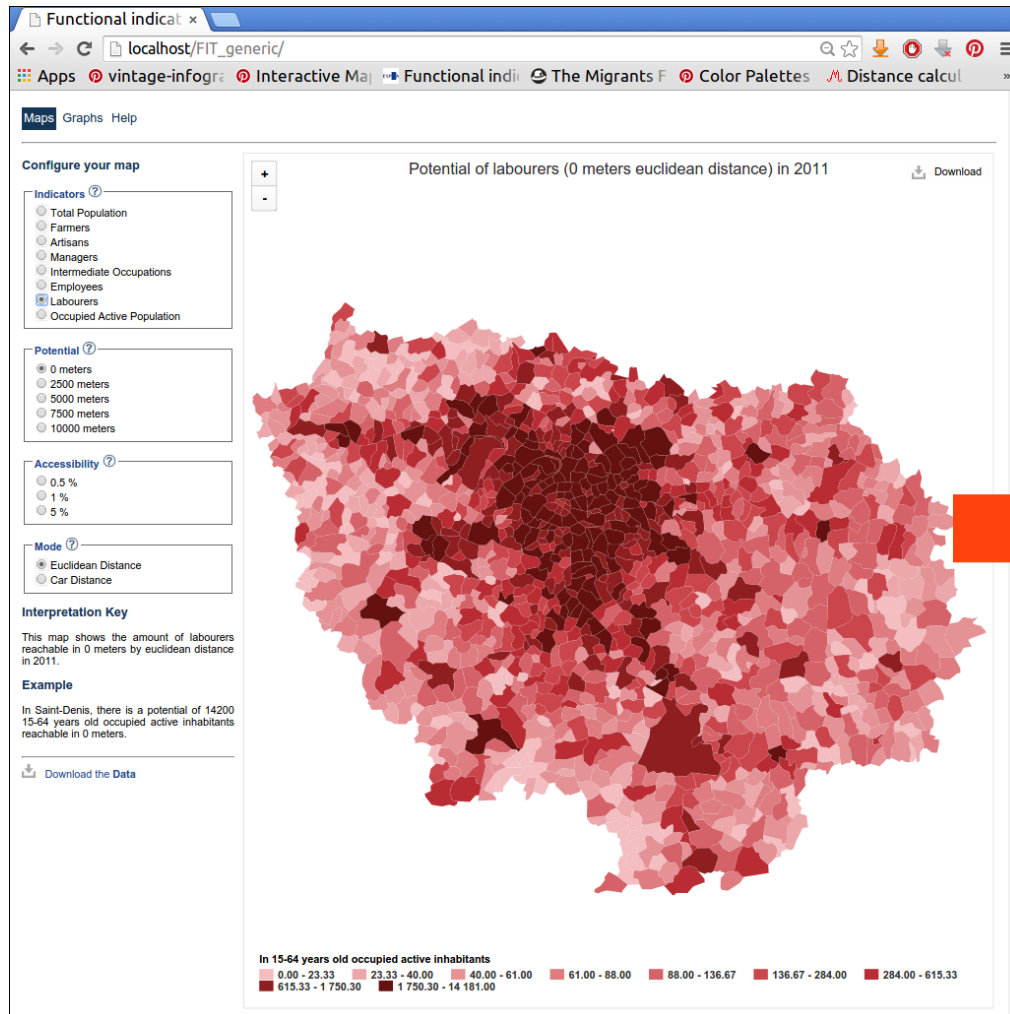
Fichier Édition Affichage Insertion Format Outils Données Fenêtre Aide

Libération Sans 10

A23

	A	B	C
1	ID	NAMES	POP_2011_road_POT_120
2	***	***	***
3	NL337	Agglomeratie Leiden en Bollenstreek	7161878
4	DEB19	Rhein-Hunsrück-Kreis	7144974
5	DE139	Lörrach	7141355
6	DEB3G	Kusel	7139138
7	ES300	Madrid	7131001
8	NL332	Agglomeratie 's-Gravenhage	7124455
9	***	***	***
10	DE40A	Oberhavel	6234474
11	FR714	Madrid	6233466
12	ITC14	Verbano-Cusio-Ossola	6221013
13	ITI43	Roma	6209742
14	DE274	Memmingen, Kreisfreie Stadt	6203199
15	NL 230	Flevoland	6195153

# Do it yourself



[https://github.com/Groupe-ElementR/\(available soon\)](https://github.com/Groupe-ElementR/(available soon))

# Thank you

<http://rgeomatic.hypotheses.org/>  
<http://neocarto.hypotheses.org/>

<http://fit.espon.eu/>  
<http://www.ums-riate.fr/funci/>

